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HUNT'S HANDBOOK.

VOLUME I.

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177. e. 14

HANDBOOK

TO THE

INDUSTRIAL DEPARTMENT

OF THE

International Exhibition,

1862.

By ROBERT HUNT, F.R.S., F.S.S.
KEEPER OF MINING RECORDS.

Published with the AUTHORITY OF HER MAJESTY'S COMMISSIONERS, *and Sold within the Building by their Sanction.*

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INTRODUCTION.

I.—On International Exhibitions.

It is a fact, rendered evident by the history of human progress, that while any people are excited to exercises of the mind, they advance; but, whenever any lethargy depresses the mental powers, or sensual passions disturb them, they retrograde in the scale of civilization. By the Infinite Mind, matter was organised into a Living Creation—and that Life was regulated, in His highest work, by the infusion of a power, gifted with the attribute of thought. Thought is the motive power by which man is moved onward. As the heat which urges forward the locomotive engine is originally derived from the sun, so the impelling Force which raises mankind above the animal existences is a gift from God. That gift, if properly employed, imparts an influence by which dead matter can be changed into forms of beauty;—by which man can recombine the elements, thus creating new conditions;—by which he can control the mighty Forces employed to regulate the great phenomena of Nature, and use them as ministers of his will.

In the International Exhibition we have a splendid manifestation of this. We may study here the gradual strengthening of thought, and the increased power gained by its healthful exercise. We may discover,—if we will but endeavour to read the Exhibition by the simple and pure light of that truth which exists in every man,—where there is an advance, and where the movement has been a retrograde one.

It must be allowed that education in a wrong direction too frequently destroys this power, or throws a coloured cloud around it, by which the meretricious is made to appear the beautiful; and, under the cloak of fashion, a monstrous development is palmed upon us as a mould of symmetry—a form of grace.

Pass, however, amidst the crowds which throng the Exhibition building, on its busiest days, and mark with care those things which attract the attention of the multitude. It will then be found that there is a latent power, which is strong to resist the influences of fashion, and which causes the eye to dwell upon those objects which reflect back, as it were, the light of that thought which has been expended in their creation.

From the Metalliferous Ores which are exhibited by each Country in its 1st Class, we are enabled to proceed by tolerably easy steps to the metallurgical products, and from them to the metallic manufactures, until in the Western Annex we may look with surprise on machines which are so entirely the creations of intense thought, that they appear almost to think themselves.

The 2nd Class informs us of the composition of Matter, and teaches us how we may recombine the elements, and produce new things. We are instructed that, from a block of coal, we may obtain not only Light and Heat, but fragrant essences and brilliant dyes. Again, we are instructed that the Earth holds things yet undiscovered, which may become most useful to man. The metal of Clay,—Aluminium,—has just taken its place among the elements of manufacture; but Thalium, an entirely new discovery, a metal resembling Lead, is here for the first time shown to the world. The Vegetable and the Animal Kingdoms contribute to our gathering. The fibres are well displayed, and we have in many of the Foreign and Colonial departments fine examples of those vegetable products, and of the uses to which they are applied. Grains, seeds, nuts, barks, and woods, tell us a striking tale of the fertility of the Earth; and we find many beautiful examples of the useful ends, and the ornamental purposes to which they are applied. The animal products are not so numerous; but with their many applications they form interesting and instructive groups.

Upon these three classes, and the class devoted to Philosophical Instruments, every result which is exhibited depends. Let us look at any of the collections of metal manufactures, whether they include the precious metals and their imitations, or the humbler forms which the, so-called, baser metals are moulded into: let us examine the works of the potter—from the most delicate porcelain, ornamented in the highest art, to the vase of terra cotta —the pitcher of yet humbler clay, down to the common brick. Let us move amongst the productions of the loom; from the gauzes, which might drape the sylph of a poet's dream, to the woollen cloths which are well devised to enable man to endure the transitions of climate. In each and in all we shall find, at every step, the dependence of the manufacturer on the unobtrusive teachings of Science. Yet with all this teaching power, how few are taught! thousands of people visit this vast storehouse of man's industry, and they leave it with a bewildered mind. How many are there who declare, after having spent days in the Exhibition, that they know not what they have seen? How few are those who can, upon the instant, even fairly describe the contents of any given court? Why is this? Is it not to be lamented that the high purposes of so grand a gathering should be allowed to pass away, like the frivolities of an ordinary fair? Need this be? No! surely measures should be taken to prevent it. The World has striven to give us good examples of its powers: Nations and Men have alike answered to our call, and entered into this industrial contest with a zeal which speaks loudly of their desire to cultivate the arts of Peace, and to weave closely the bonds of friendship.

A record worthy of the occasion should be produced: not merely a Report of the contents of each class, but a philosophical examination of the real value to the World of the articles exhibited. Let us hope that the Reports of the Jurors will supply this want. At the same time let us urge upon Her Majesty's Commissioners the duty, imperative upon them, of securing, at any cost, the efforts of the best-trained minds in the production of a systematic examination of this display of the World's Industry.

If International Exhibitions are to serve any great purpose, it is to quicken the powers of human thought, and to give to man still superior control over the materials of which our world is formed.

The human element cannot be separated from the Divine one, so long as body and mind are chained together. As long as the material man is yoked to the immaterial soul, there must be in all the outward manifestations of human power a mixture of conditions. Thus we find the highest efforts of intellect stained by the earthiness of life, or distorted by the struggles under which they have been produced.

The Exhibition of 1862 has a large leaven of the commercial element in it, and without this it would never have quickened into existence. Every one must have heard it called a vast Bazaar—a great shop. If it had not been this, it would have been nothing. Men have spent their thousands, and racked their brains to produce something which, from its excellence, would be certain of realizing a money value. And this is not confined to the mere manufacture: it is equally the case with the poetic creation of the painter; and the sculptor chisels his marble into a Sibyl, a Cleopatra, or a Venus, that he may realize fame and wealth.

The exciting power is therefore the commercial one, but out of its earthiness there rises a purer one, and to that the attention of the visitors to this International Exhibition should be directed.

The object has been in some cases to be eminently useful, to meet the necessities of existence in all their conditions; and, to the inventor of a plan—the constructor of a method, by which the amenities of life can be increased, a large debt is due. In other cases the study has been to please, and whenever pleasure is produced without sacrificing the laws of nature, good is the psychological result. Truth in form, and harmony in colour are great teachers, and these may be produced in the cup from which a peasant drinks his beer, as well as in the jewelled vase from which the prince may sip his costly wine; or in the woollen garment of a village maiden equally with the silken robings of a titled lady.

Under the impression, that amidst the thousands, who flock from every part of the land, a large number come to the Exhibition desirous of learning something from it, this Handbook has been undertaken. Its execution is imperfect, from the necessity of producing it within a given, and that a short, period. It is not in any of its parts so clearly descriptive as is to be desired: the limits of space have rendered this impossible. All that it has attempted to do is to give a sufficient description of the groups exhibited, to enable the observer to direct attention to the points of interest which are involved in their production. This HANDBOOK aims at taking the place of a Text-book; it merely explains—or endeavours to explain—the peculiarities of the articles exhibited. The full examination of the modes of manufacture,—of the principles involved in design, or figured forth in colour—of the nationailties, which are so marked, and which form so pleasing a study—must be left to other minds.

All that has been attempted has had close and serious attention; and it is hoped that the following pages may furnish every inquiring reader with at least so much information as will render the collection generally instructive, and make it more interesting by being so.

Although maintaining the position of an author, the labour bestowed upon this work partakes much of the character of that of an editor. Assistance of the most valuable character has been afforded, and contributions to the general matter given, by several gentlemen well qualified by their studies to impart information. To Mr. Sydney Whiting—the editor of the Industrial Catalogue—this work is indebted for much of the matter included in the description of Furniture, the Decorative Arts, and of Glass. Mr. C. W. Quin's aid in the section devoted to Chemistry was valuable. To Mr. C. R. Weld the Essay on Philosophical Instruments is mainly due; and to Mr. J. Leighton we owe the remarks on the class embracing Paper, Printing, &c.—the instruments, indeed, for the diffusion of knowledge. The vegetable products of the colonies have been described by Mr. P. L. Simmonds. These gentlemen have been so entirely connected with the classes on which they have written, that more competent writers could not have been selected to insure a careful guidance to those divisions of the collection. The machinery and engineering of the Exhibition have either been described by Mr. Bauerman, or the materials of description have been collected by him. The study of ecclesiastical architecture and church decoration having been long an earnest one with that gentleman, he has kindly contributed remarks on these subjects. To Mr. Herbert Lindon an especial debt is due from the author, since he he has not only supplied original matter, but by the assiduity with which he has collected special information from the exhibitors, he has placed in the author's hands the means of giving more correctly, than he could otherwise have done, descriptions of processes and results. Mr. C. H. Smith, so well known for his acquaintance with our building-stones has contributed the Essay in Class X. on the stones used in construction. To Mr. M. J. Harpley, of the Royal Horse Guards, Mr. S. Piesse, and to many other gentlemen, engineers and manufacturers, the author is bound to make his acknowledgements; and he is greatly indebted to the exhibitors as a body, who have answered his applications for information with promptness, and in the most liberal feeling.

It has been thought that a brief guide to the more remarkable groups would be found of use; therefore the following general Synoptical View has been given. A more complete guide will be found in the author's *Synopsis of the Contents of the International Exhibition*.

II. SYNOPTICAL VIEW OF THE INTERNATIONAL EXHIBITION.

THE purpose of this sketch is to lead the observer, who desires to make himself familiar with the striking features and instructive objects of the Exhibition, by such a route as will enable him to establish a sequence in his mind, between the raw materials as given to man by Nature, and the elaborated productions of human skill. An endeavour will be made to show the succession of objects which should have been observed, indicating where they are to be found. It must not be supposed that, by this remark, any reflection on the order of arrangement which prevails is intended. No one knows more perfectly than the author does, the impossibility of so ruling the caprices of such a multitude of exhibitors, as to compel the observance of anything like a methodical arrangement of their productions. We have, therefore, to take the Exhibition as it stands—vast, and certainly, to those minds well trained in systems of method—irregular,—and endeavour to obtain from it as much instruction as possible.

At the base of every British industry, we find our, mineral wealth. Deprive the United Kingdom of coal iron, copper, and tin, and no effort on the part of the people could maintain this country in the proud position she now occupies.

The first in order of study should therefore be *Class* I., placed in the EASTERN ANNEX. The coals, the iron ores, and other metalliferous minerals from the more important of our mining districts are here. Building-stones, clays, and sands, are also exhibited—many of them in well-arranged groups—some of them but imperfectly displayed. Our metallurgy, especially of iron, copper, tin, and lead, forms a portion of the same group—and manufactures from our ornamental stones will be found in pleasing contrast to the rude works of the modern Cyclops. Two cases in this Class, one the applications of aluminium, and of the beautiful alloy, aluminium bronze ; and the other containing a remarkable mass of platinum—apparatus made of that valuable metal—and also some rare metals, in masses such as were never before seen, are amongst the most striking in the Exhibition.

CHEMISTRY, *Class* II., follows this class, and there certainly never was gathered together, so fine a collection of chemical products as this. The Magenta crowns, although altering a little by exposure, are still striking objects; and as illustrating the dyes obtained from what was formerly the refuse of our gas-works, they are eminently instructive. It is not possible, where all is excellent, to select any one series for special notice. It is questionable if any one living will ever again have the opportunity of seeing so complete a series, or chemicals of so fine a character, or on so grand a scale.

FOOD, *Class* III., follows this, but it should certainly have been preceded by VEGETABLE AND ANIMAL SUBSTANCES USED IN MANUFACTURES, *Class* IV. Indeed the raw materials, from the three kingdoms of nature, should have been arranged in immediate connection. FOOD, however, follows on Chemistry, and this section is the least satisfactory of any in the Exhibition. Those who exhibit, have made fairly complete collections, but there are most important sections of this Class unrepresented. *Class* IV. is far more satisfactory, and here will be found much that will interest every observer.

Beyond this Class will be found MACHINERY *not in motion*. This is a very miscellaneous group, containing many most ingenious machines; several traction engines and railway carriages. This group can only be studied to advantage after the visitor has familiarized himself with the machinery of the *Western Annex*. The Western division of this, *the Eastern Annex*, is devoted to AGRICULTURAL AND HORTICULTURAL MACHINES AND IMPLEMENTS, *Class* IX. The cultivators of the soil, and all who are interested—as who is not—in the improvement of agriculture, will find much to interest them here. The things exhibited form the fifth section of this work. Such are the classes contained within the *Eastern Annex*, and the importance of these must be sufficiently evident.

Returning from the Annex we enter the BRITISH COLONIAL POSSESSIONS, in the *North Western Transept*.

Canada stands prominent with her trophy of timb and her remarkable mineral collections.

Newfoundland, the most ancient of our colonies, has a small collection beneath the Gallery, exemplifying her fisheries and her minerals.

New Brunswick and Prince Edward's Island follow Canada, and these again are followed by Vancouver and Nova Scotia, the latter being marked by a pillar of coal representing one of the thickest seams of coal in the world. Nova Scotia shows a choice collection of gold ores and minerals, with her vegetable and animal products, beneath the Gallery on the Western side of the Transept.

Malta is well marked,—under the Eastern Gallery,—by the filigree silver work exhibited, and the vases carved in soft stone, for which that island has long been famous.

Ceylon—that interesting island—shows her vegetable and animal productions here, and is followed by the West India Islands, with a small but satisfactory collection of their products and manufactures.

Tasmania rears aloft her spars, and leads us to her mineral and other productions, which though so crowded as to demand a little labour, will well reward the industry of any one.

Victoria shows us the mass of gold which has been produced since 1851, in the pyramid which rises into the Eastern Dome, while in a case below the Daïs, is indeed a remarkable collection of the precious metal. This energetic colony displays the elements of a future greatness, in the zeal with which the collection exhibited has been brought together, and in the character of the products exhibited.

South Australia occupies the North-east corner from the Eastern Dome: the minerals displayed are remark-le, the woods are valuable; and, indeed, all her prouctions are of great commercial interest.

New South Wales follows the next in order along the Nave. Gold again glitters in our eyes; numerous minerals are shown; vegetable products assume a place of importance; and the animal kingdom is well represented.

New Zealand is placed under the Gallery fronting the Nave. The gold from Otago is the most prominent object. Western Australia has her collection behind that of New Zealand: and Queensland has its place immediately behind New South Wales. Such is the interesting group with which are comprehended a set of colonies which will probably rise into empires, and perpetuate and extend the civilization they have derived from the parent country.

Natal—our African colony—has a place immediately north of New Zealand, and that space is filled with objects of interest. Omitting the small collections, which are of an imperfect character, if we ascend the stairs we have the fine collection from India in the Gallery on the Western side of this, the *North-east Transept*. Orientalism, in all its luxury, its ingenuity, and its examples of the expenditure of long periods of time to produce small, yet still beautiful effects, is here to be seen. Associated with these there are works of the loom and other manufactures which promise to take a good position in the markets of the world.

It becomes necessary, from the Gallery devoted to India to descend and stand on the Daïs beneath the Eastern Dome.

In the *South-eastern Transept* are some groups belonging to *Classes* X., XXXI., and XXXII. These are the architectural courts on the Eastern side under the Gallery. The Rood-screen for Hereford Cathedral, and some associated productions of an analogous character, are prominent objects. In the same Class is a collection of Renaissance metal work, some of it beautiful, much of it quaint; and in two Courts, on the Eastern side under the Gallery, we have similar and, indeed, more complete collections of Ecclesiastical ornaments, and Church Furniture. The Coalbrookdale Company exhibit beautiful gates, and fine iron and bronze castings, while in the centre of this Transept we have some large examples of the process of producing steel, known as that of Bessemer. Another set of illustrations of STEEL MANUFACTURE, *Class* X., are the steel bells of Naylor, Vickers, and Co.—the tyres, cranks, and other pieces of machines —Warner's bells of ordinary bell-metal, belong to *Class* XXXII., and may be said to mark the entrance to that Class.

There is also Dent's clock, striking the hours on its ponderous bell.

Classes XXV., SKINS, FURS, &c., and XXVI., LEATHER, will be found at the South-east corner of the *Iron and General Hardware Court*, and in the South-eastern Tower will be found the small contribution from the UNITED STATES.

At the South-western corner of the Eastern Daïs is *Class* X., Civil Engineering and Construction. In this Court is Mr. Vignolles' model of the Bilboa Railway, which is one of the most perfect of models; and as illustrating a scene full of historic interest, should be seen by all.

Class XXXII., IRON AND GENERAL HARDWARE, follow upon this in the South Court. Sheffield, Birmingham, Wolverhampton, indeed, all the marts of metal manufacture, are represented here, and associated with *Class* XXXIII., STEEL; the collection—which is a very large one —presents much to admire and not a little to condemn. In many examples, good taste prevails; in some, a meretricious style shows the imperfect education of our art manufacturers.

MILITARY ENGINEERING, *Class* II., follows Civil Engineering along the Nave. Here may be studied the beautiful pieces of ordnance constructed by Sir William Armstrong; the great guns from well-known makers, small arms in large number, and most of the appliances of war.

NAVAL ARCHITECTURE, *Class* XII., is immediately associated with the above. Models of our finest ships will prove the attention we have given to their structure; and the Lighthouses which surround our dangerous coasts, of which there are many models, prove how carefully we have endeavoured to protect the mariner from the dangers of our shores.

All these Classes are the result of a considerable elaboration of processes by which nature's products have been applied. The most beautiful of manufactures, GLASS, *Class* XXXIV., follows here. As the result of the combination of flint with an alkali, there is nothing in the range of human discovery more striking than this; and the present display will prove that the glass produced by our manufacturers excels any that was ever produced by any people. In some of the curiosities of the glass-house, the works of Murano may have surpassed us, but in the beauty of material, they never approached the purity which is to be found in the collection displayed.

POTTERY, *Class* XXXV., is adjoining the Court devoted to Glass. From tiles and terra cotta—of the latter there are some choice examples as regards form—we have every description of earthenware, and many fine examples of porcelain. Whether the re-introduction of the Majolica is to be regarded as an advance, is a point upon which very adverse opinions will be held.

The PROCESS COURT, which is immediately connected with this, has ever been a point of interest; needle-making, sewing machinery, type composing and distributing, pipe-making, printing, and some other processes, are in full operation.

In the Nave are cases rich in the PRECIOUS METALS AND THEIR IMITATIONS, AND JEWELLERY, *Class* XXXIII., and this valuable portion of the exhibition is continued along the Central Avenue, and the Nave on the Southern side. Art, in many cases of a very high order, has here allied itself with manufacture of the most refined character. Gems of great beauty and of immense value are displayed, and the jewellery is of the most brilliant order. To particularize any one exhibitor, without entering into a detail of the collection, would be unfair; this is therefore avoided.

On the North side of the Nave, MUSICAL INSTRUMENTS, *Class* XVI., are displayed in considerable variety; and extending eastward in this the *Northern Court*, *Class* XXX., FURNITURE, PAPERHANGING, AND DECORATION, occupy a large space. These are all described in the following pages.

FOREIGN STATES.

Section I.

All the space to the West of the Central Avenue is occupied by the exhibition of industrial works and natural products, contributed by Foreign countries.

ITALY occupies the space at the corner of the Central Avenue and Nave, exhibiting a fine collection of minerals, many interesting manufactures, and works of art.

ROME may be regarded as an extension of the Italian section, and in her Court, Art asserts its supremacy. The "Sybil," and the "Cleopatra," with other statues, are constant sources of admiration. The Mosaics are curious examples of enormous industry.

PORTUGAL immediately follows Italy on the south side of the Nave, with a large collection of mineral and vegetable products.

SPAIN follows her sister country, and exhibits many fine examples of textile manufacture, some ceramic works, jewellery, watches, and other evidences of taste and ingenuity. Her minerals are in the Gallery.

FRANCE is well marked by the large iron screen in the Nave, and by the castings in bronze and zinc which adorn the entrance to this extensive court. The works in the precious metals, the jewels, and no less, the really remarkable imitations of pearls and precious stones, are points of attraction. The special manufactures of this great country, and her natural productions, are well represented.

PRUSSIA, and the twenty-two other states which constitute the commercial union known as the ZOLLVEREIN, occupy the *Western Transept*, on the south of the Western Dome, and some space in the *South-Western Tower*. The industries of these countries are well displayed; the finest types of manufacture being arranged near to and around the Daïs under the Western Dome. Works of art, in the shape of bronze castings, and numerous fine examples of art manufacture, are distinguishing features in this collection.

The HANSE TOWNS, BREMEN, HAMBURG, and LUBECK, occupy spaces near the Zollverein groups.

AUSTRIA, with HUNGARY, fill the northern side of this Transept. *Glass* and *Porcelain*, Musical Instruments, Cabinet work, and Metallurgical productions, are fully shown. Educational works, and a considerable variety of the higher class productions, for the dissemination of which we are indebted to the printing press, or to the engraver, claim attention. The display of wines is something remarkable.

At this point the visitor will enter the

WESTERN ANNEX.

The machinery displayed in these arcades may be safely declared to be the most surprising efforts of human ingenuity the world has ever seen. Returning from its examination, we pass again into the

WESTERN TRANSEPT,

and proceeding Eastward, continue our examination of the Foreign countries.

FOREIGN STATES.

Section II.

On the Northern side of the Nave, passing Eastward, will be first found—

BELGIUM, with a large and beautiful display of cloths, fine illustrations of her iron manufacture, and numerous other works distinguishing this unpretending but industrious people.

HOLLAND is rich in wood-carvings; the woollen manufactures are good, and the colonial produce exhibited is well worth attention; and the great diamond, the "Star of the South," is a distinguishing feature.

SWITZERLAND, rejoicing in her watches and her delicate manufactures, comes next in order. The wood-carvings are well known, and her textile manufactures of their usual excellence.

DENMARK, with the Scandinavian drinking-horns, embellished with the beautiful legends of the North, follows Switzerland. Furs show the latitude from which this collection comes, and it is a collection full of great interest.

SWEDEN and NORWAY are rich in their mineral products. Their wonderful iron ores, and the ores of zinc and copper, show how richly stored is this land. Silver and other manufactures form a pleasing class.

RUSSIA, distinguished by the columns of jasper and malachite, by an extraordinary display of plumbago, a remarkable mass of Nephrite, a large collection of Siberian furs, and numerous examples of textile and other manufactures, comes next amongst the European states.

Orientalism, in all its glitter and its luxury, next meets us, and we find ourselves in TURKEY. Amber mouthpieces, "the gem-adorned chibouque," and embroidered vestments, plainly mark the land from which they come.

BRAZIL has a place immediately adjoining Turkey. The advance of this vast empire is predicated in the collection shown. The vegetable products and woods are very remarkable. The mineral productions prove the country to be one of great resources, and her manufactures speak of no common interest.

GREECE has place by Brazil, and she still lingers on the traditions of the past. Marbles of Pentelicon, busts—in her marbles—some minerals, and a few manufactures, are the distinguishing features

The SOUTH AMERICAN REPUBLICS form an interesting group, near the entrance to the Horticultural Gardens, on the Western side.

On the Eastern side of the Central Avenue we find CHINA and JAPAN, with their curious carvings and their wonderful porcelain—examples of the perfection of some manufactures, combined with a taste which is trammelled by a most ancient superstition.

THE IONIAN ISLANDS, ST. HELENA, the MAURITIUS, and the CHANNEL ISLANDS are grouped near this.

THE GALLERIES.

If the Galleries are approached by the stairs at this point, the visitor enters the space devoted to EGYPT—

and here is the most remarkable collection from the tombs of her monarchs—which includes the jewellery of Aah-Hoteh, the mother of the first king of the twenty-eighth dynasty. The interest which attaches to this remarkable collection makes us forget the impropriety of having it in an exhibition devoted to modern industries. One purpose, however, is served by it—moderns may learn that they have not advanced so far beyond the ancient Egyptians, who lived when Israel was in bondage, as they have flattered themselves into believing.

Passing eastward—DRESSING CASES, &c. (*Class* XXXVI.), PHILOSOPHICAL INSTRUMENTS (*Class* XIII.), SURGICAL INSTRUMENTS (*Class* XVII.), HOROLOGY (*Class* XV.), and PAPER, STATIONERY, &c. (*Class* XXVIII.), follow from this point. Descending at the eastern end of this Gallery, and crossing the Daïs, we shall, if we ascend the stairs on the other side, reach the examples of the TEXTILE MANUFACTURES of the United Kingdom. It is not necessary to occupy space by particularizing those classes, which are full of splendid examples of the perfection to which the works of the loom have been brought in this country.

The Galleries around the Western portion of the building are devoted to the Foreign countries; each division corresponding with the arrangements on the ground floor, or nearly so. It is hoped this sketch, with the Index, will render it easy to discover every object exhibited.

Europe has felt a common sorrow with us in the great loss which this nation has sustained. A far-seeing mind has been extinguished—a directing eye has been closed, and a guiding hand paralyzed.

"The silent father of our kings to be"

has, however, left his spirit-light amongst us. His thoughts live—his words yet triumph over the conqueror to whom mortality succumbed; and no more appropriate introduction to the present gathering can be found than the words which Prince Albert uttered, when the Great Exhibition of 1851 was struggling to its birth:—

> "The products of all quarters of the globe are placed at our disposal, and we have only to choose which is the best and cheapest for our purposes, and the powers of production are intrusted to the stimulus *of competition and capital.*
>
> "So man is approaching a more complete fulfilment of that great and sacred mission which he has to perform in this world. His reason being created after the image of God, he has to use it to discover the laws by which the Almighty governs his creation; and, by making these laws his standard of action, to conquer nature to his use—himself a divine instrument.
>
> "Science discovers these laws of power, motion, and transformation: industry applies them to the raw matter, which the Earth yields us in abundance, but which becomes valuable only by knowledge. Art teaches us the immutable laws of beauty and symmetry, and gives to our productions forms in accordance to them. The Exhibition is to give us a true test, and a living picture of the point of development at which the whole of mankind has arrived in this great task, and a new starting-point, from which all Nations will be able to direct their further exertions.
>
> "I confidently hope that the first impression which the view of this vast collection will produce upon the spectator, will be that of deep thankfulness to the Almighty for the blessings which he has bestowed upon us already here below; and the second, the conviction that they can only be realized in proportion to the help which we are prepared to render each other, therefore, by peace, love, and ready assistance, not only between individuals, but between the nations of the earth."

STATUES AND BUSTS.

It has been suggested that the following List would be convenient and useful.

EASTERN DOME.

Casts for the Use of Schools . .	D. BRUCCIANI.

Commencing at the N. E. Corner.

Robert Fitzwalter	F. THRUPP.
Dr. Wood	E. H. BAILY, R.A.
Australia. "Advance, Australia!" .	I. BELL.
Religion . . . . . "Daughter of Grace! Religion!"	J. EDWARDS.
Saher, Earl of Winchester . . .	J. S. WESTMACOTT.
Richard, Earl of Clare . . .	H. TIMBRELL.
Adam. (Imperial Government). Sir James Outram . . .	M. NOBLE.
Samuel Crompton	W. C. MARSHALL, R.A
Cromwell. "In my defence God me defend"	I. BELL.
Satana	C. CORTI.
Lord Clarendon	W. C. MARSHALL, R.A.
Josiah Wedgwood	E. DAVIS.
Milo	J. G. LOUGH.
Mercy on the Battle-field . . .	E. B. STEPHENS.
La Pieta	A. CARLI.
Lord Bacon	T. WOOLNER.
Henry Hallam	W. THEED.
Miss Nightingale	
Dr. Babington	W. BEHNES.
The Fortune Teller	T. E. CAREW.
Cornélie. (Imperial Government) .	J. PAVELIER.
Bacchante	
Eustace de Vesci	A. H. RITCHIE.
William de Mowbray	Ditto.

Rebecca	E. Davis.
Armed Science	I. Bell.
Dr. Isaac Barrow	M. Noble.
William Earl of Pembroke	J. E. Thomas.

The Nave—North Side.

Lion	C. Anonyme.
La Maddalene	L. Pampaloni.
La Rassegnazione	G. Celaroni.
Lioness	M. Campana.
Mrs. W. F. Fairbairn	M. Noble.
Her Majesty the Queen	T. Earle.
Edward VI.	Baron de Triqueti.
The Earl of Carlisle	J. E. Jones.
"Non Angli sed Angeli"	Sharp.
The Duke of Newcastle	M. Noble.
"Clio"	J. Lawler.
The Marquis of Lansdowne	M. Noble.
The Earl of Ellesmere, K.G.	Ditto.
"Ariel"	R. Westmacott, R.A.
Amenophis III. (Imitation marble)	
Mrs. Warner	E. Foley
Two Children	H. Ross.
The Duchess of Wellington	J. Gibson, R.A.
"L'Allegro"	T. Earle.
Lord Elphinstone	M. Noble.
"California"	H. Powers, U.S.A.
"Moses" (Lent by the Science and Art Department)	Michael Angelo.
A Georgian Lady of the Harem	R. Monti.
Daphne	M. Wood.
Atalanta	Sir G. Hayter.
"Home, Sweet Home!"	H. Ross.
Napier	Adams.
La Desalazione	F. Spaventi.
Sir W. C. Ross, R.A.	P. Park.
The Surprise	P. Bosch.
Thorwaldsen	A. Thorwaldsen.
Mercury	Ditto.
Jason	Ditto.
H. C. Orsted	

Girl Feeding Doves	
Charles Kean	T. Butler.
Nymph and Cupid	E. Thrupp.

The Nave—South Side.

The Statues belonging to Belgium and the Zollverein commence here and extend round the Western Dome.

Bacchante	T. Sharp.
Flora	Ditto.
The Greek Slave (reproduced in imitation marble by D. Brucciani)	J. Powers, U.S.A.
W. Shean	T. Woolner.
A. Shepherd	Spence.
La Maddalena	Adelaide Pandiani.
La Vergine Camilla	Botenelli.
Count Cavour	V. Giani.
Victor Emmanuel	C. Albertoni.
Garibaldi	Romanelli.
L'Indiana	P. Costa.
Cobden	E. G. Papworth, Jun.
Eva	Pietro dal Negro.
The Earl of Clarendon	J. E. Jones.
Boy and Serpent	B. Delisi.
Viscount Palmerston	J. E. Jones.
Nymph	E. H. Baily, R.A.
Sir F. Burdett	G. G. Adams.
Orphan Flower Girl	J. D. Crittenden.
Prince of Wales	J. Steele, R.S.A.
Cromwell	M. Noble.

Centre of Nave.

La Nostalgia	A. Tantardini.
Cleopatra	E. Rancati.
Caractacus	E. H. Baily, R.A.
Samson Slaying a Lion	T. Milnes.
La Filia di Sion	S. Salvini.
Memory	W. Brodie, R.S.A.
Wellington	G. G. Adams.
Night	A. Gatley.
Child with Watch	M. Noble.

St. John	G. Adams.
Princes in Tower	Mrs. Freeman.
Diogenes	R. Barbera.
The Eagle Slayer	J. Bell.
St. Jerome	P. Ricca.
Titania	T. Earle.
The Sleep of Sorrow and the Dream of Joy	R. Monti.
The Industrious Girl	G. Fontana.
Venus Anadyomene	C. A. Franklin.
The Young Minstrel	G. Adams.
Girl with Dove	L. Fontana.

INDEX TO VOL I.

	CLASS.	SITUATION.	PAGE
Abel's fuses for blasting by magneto-electricity	I.	*Eastern Annex* .	68
Accoutrements and camp equipage	XI.	*South Court* . .	356
Acetic acid	II.	*Eastern Annex* .	99
Agricultural carts	IX.	*Eastern Annex* .	212
AGRICULTURAL AND HORTICULTURAL MACHINES AND IMPLEMENTS	IX.	*Eastern Annex* .	180
Agricultural produce	III.	*Eastern Annex* .	138
Agricultural steam-engines . .	IX.	*Eastern Annex* .	180
Alabaster	Sub-Class X.C. & XXXI.	*Eastern Transept and Annex* . .	331
Alkalies and their compounds .	II.	*Eastern Annex* .	101
Alum	II.	*Eastern Annex* .	111
Aluminate of soda	II.	*Eastern Annex* .	106
Aluminium	I.	*Eastern Annex* .	5
Aluminium	XXXI.	*South Court* . .	446
Anarcotin	Sub-Class II.B.	*Eastern Annex* .	134
Anatomized leaves and preserved model flowers	IV.	*Eastern Annex* .	170
Anchors	XII.	*South Court* . .	362
Aniline, and aniline dyes . . .	II.	*Eastern Annex* .	119
ANIMAL AND VEGETABLE SUBSTANCES USED IN MANUFACTURES	IV.	*Eastern Annex* .	150
Anthracite	I.	*Eastern Annex* .	61
Antimony and its oxides . . .	II.	*Eastern Annex* .	127
Apparatus for blasting roots and stumps of trees	IX.	*Eastern Annex* .	216
Apparatus for lowering boats from ships at sea, in rough weather .	XII.	*South Court* . .	369
Apparatus for obtaining fresh water from sea water . . .	VIII.	*Western Annex* .	278
Architectural sculpture and embellishments	X.	*Eastern Transept*.	335

	CLASS.	SITUATION.	PAGE
Arsenic	I.	*Eastern Annex*	79
Artificial ultramarine	II.	*Eastern Annex*	125
Automaton mint weighing machine	VIII.	*Western Annex*	281
Balances, weighing-machines, and weights	XXXI.	*South Court*	441
Basket-work	IV.	*Eastern Annex*	171
Baths and lavatories	X.	*South Court*	306
Battery for the protection of river mouths and harbours	XI.	*South Court*	355
Bedsteads	XXXI.	*South Court*	414
Bells	XXXI.	*South Court*	442
Bee-hives	IX.	*Eastern Annex*	220
Benzole	II.	*Eastern Annex*	113
Bichromate of Potash	II.	*Eastern Annex*	109
Biscuits	III.	*Eastern Annex*	148
Blacking	Sub-Class II.B.	*Eastern Annex*	136
Blocks for shawl printing	VII.	*Western Annex & Process Court*	255
Blowing-engines and ventilators	VIII.	*Western Annex*	268
Boat building by machinery	XII.	*South Court*	380
Boat building for pleasure and racing boats	XII.	*South Court*	380
Boilers (including tubes, pressure and water gauges, counters and indicators, and steam, gas, and water fittings)	VIII.	*Eastern Annex*	231
Boracic acid	II.	*Eastern Annex*	97
Boring machine and expanding wedge	I.	*Eastern Annex*	85
Bottling and corking machines	VIII.	*Western Annex*	282
Bottling machine	XXXI.	*South Court*	446
Branding irons	XXXI.	*South Court*	446
Bread and biscuit machinery	VIII.	*Eastern Annex*	273
Breakwaters	X.	*South Court*	299
Breech-loading rifles	XI.	*South Court*	353
Brewery machines and coolers	VIII.	*Western Annex*	277
Bricks	X.	*Eastern Transept*	334
Brick-making machines	VII.	*Western Annex & Process Court*	261
Bridges	X.	*South Court*	293
British gold	I.	*Eastern Annex*	8
Bronzes	XXXI.	*South Court*	445
Brown hematites, brown oxide of iron, hydrous oxide of iron	I.	*Eastern Annex*	44

	CLASS.	SITUATION.	PAGE
Cairngorms, and other minerals from Portsoy	I.	*Eastern Annex*	10
Caking coal	I.	*Eastern Annex*	59
Calcareous saponification	IV.	*Eastern Annex*	154
Campticon, or consolidated oil	IV.	*Eastern Annex*	159
Candelabra, lamps, wicks, chandeliers, brackets	XXXI.	*South Court*	412
Candles	IV.	*Eastern Annex*	154
Cannel, or parrot coal	I.	*Eastern Annex*	59
Captain Cole's revolving cupola shield	XII.	*South Court*	361
Carbonate of potash	II.	*Eastern Annex*	109
Carbonates of protoxide of iron	I.	*Eastern Annex*	50
Carbonate of soda	II.	*Eastern Annex*	101
Carpenters' and smiths' tools and appliances	XXXI.	*South Court*	435
Carriages	VI.	*South-East Court*	385
Carriage fittings, wheels, &c.	VI.	*South-East Court*	392
CARRIAGES NOT CONNECTED WITH RAIL OR TRAM ROADS	VI.	*South-East Court*	384
Carts, &c.	VI.	*South-East Court*	394
Cast-iron pipes	X.	*South Court*	309
Caustic potash, or hydrate of potash	II.	*Eastern Annex*	107
Caustic soda	II.	*Eastern Annex*	105
Chaff-cutters	IX.	*Eastern Annex*	210
Chains, cables, and anchors	XXXI.	*South Court*	427
Chalk, whiting, &c.	I.	*Eastern Annex*	33
CHEMICAL AND PHARMACEUTICAL PRODUCTS	II.	*Eastern Annex*	97
Chemicals used in manufactures	II.	*Eastern Annex*	97
Cherry, or soft coal	I.	*Eastern Annex*	59
Chicory	III.	*Eastern Annex*	145
Chimney-sweeping and draining machinery	XXXI.	*South Court*	445
China-stone	I.	*Eastern Annex*	31
Chloride of gold and nitrate of silver	II.	*Eastern Annex*	112
Chloride of lime	II.	*Eastern Annex*	110
Chloride of tin, oxide, &c.	II.	*Eastern Annex*	112
Chlorate of potash	II.	*Eastern Annex*	108
Chloroform	Sub-Class II.B.	*Eastern Annex*	132
Chocolate and cocoa	III.	*Eastern Annex*	143
Church furniture	XXXI.	*South Court*	396
Churns and dairy implements	IX.	*Eastern Annex*	218

	CLASS.	SITUATION.	PAGE
CIVIL ENGINEERING, ARCHITECTURAL, AND BUILDING CONTRIVANCES	X.	*South Court* . .	289
Clays	I.	*Eastern Annex* .	26
Coach harness and horse furniture	XXXI.	*South Court* . .	416
Coals	I.	*Eastern Annex* .	57
Coal-measure iron ores, argillaceous carbonates, and black band iron ores	I.	*Eastern Annex* .	47
Cobalt and nickel	I.	*Eastern Annex* .	25
Cocks and taps	XXXI.	*South Court* . .	436
Cod-liver oil, &c.	Sub-Class II.B.	*Eastern Annex* .	133
Coffee	III.	*Eastern Annex* .	142
Combs	IV.	*Eastern Annex* .	169
Compact limestone	I.	*Eastern Annex* .	38
Compasses	XII.	*South Court* . .	382
Confectionery and wedding cakes .	III.	*Eastern Annex* .	147
Copper ores	I.	*Eastern Annex* .	72
Copper pyrites	I.	*Eastern Annex* .	72
Copper smelting	I.	*Eastern Annex* .	74
Copper, zinc, and brass manufactures	XXXI.	*South Court* . .	434
Coprolites, fossil bones and biphosphate of lime manufactured therefrom	I.	*Eastern Annex* .	82
Corn mills	IX.	*Eastern Annex* .	209
Corrugated iron and zinc roofs, houses, &c.	X.	*South Court* . .	307
Cotton and silk	IV.	*Eastern Annex* .	167
Crucibles	I.	*Eastern Annex* .	32
Crushing machines	VIII.	*Western Annex* .	284
Crystalline limestone	I.	*Eastern Annex* .	38
Datura Tatula	Sub-Class II.B.	*Eastern Annex* .	135
Derbyshire marbles	I.	*Eastern Annex* .	14
Detector locks	XXXI.	*South Court* . .	421
Dioptric apparatus	XII.	*Nave*	375
Dioptric revolving apparatus . .	XII.	*Nave*	376
Distance measurer	VIII.	*Eastern Annex* .	395
Diving apparatus	X.	*South Court* . .	300
Docks	XII.	*South Court* . .	371
Dog-collars, handcuffs, leg-irons .	XXXI.	*South Court* . .	446
Dolomites, or magnesian limestones	I.	*Eastern Annex* .	36

	CLASS.	SITUATION.	PAGE
Drain and sanitary pipes	X.	*South Court*	309
Drinking-fountains	XXXI.	*South Court*	415
Driving belts and gearing	VIII.	*W. & E. Annex*	239
Drysaltery, grocery, &c.	III.	*Eastern Annex*	142
Dyes from lichens and madders	II.	*Eastern Annex*	121
Dyes, pigments, and varnishes	II.	*Eastern Annex*	119
Electric light	XII.	*South Court and Western Annex*	374
Electro-plated goods	XXXI.	*South Court*	444
Elvans	I.	*Eastern Annex*	42
Enamelled iron	XXXI.	*South Court*	424
Enamelled slate	Sub-Class X.C. & I.	*Eastern Transept and Annex*	316
English Channel railway	X.	*South Court*	292
Engraving for calico-printing	VII.	*Western Annex and Process Court*	255
Esssential oils	Sub-Class II.B.	*Eastern Annex*	132
Ether	Sub-Class II.B.	*Eastern Annex*	132
Fenders and fire-irons	XXXI.	*South Court*	445
Fifty-four gun "Receiver" frigate	XII.	*South Court*	360
Filters	X.	*South Court*	306
Fine chemicals and rare substances	II.	*Eastern Annex*	114
Fire bricks, retorts, &c.	X.	*Eastern Transept*	334
Fire-engines and escapes, hose and buckets	VIII.	*Western Annex*	266
Fire guards	XXXI.	*South Court*	445
Fire-proof safes	XXXI.	*South Court*	421
Fishing-rods, tackle, and archery	IV.	*Eastern Annex*	169
Flour mills	VIII.	*Eastern Annex*	272
Fluid extracts of opium, sarsaparilla, taraxacum, &c.	Sub-Class II.B.	*Eastern Annex*	134
Fly-presses, embossing machines, copying presses, &c.	VIII.	*Western Annex*	284
Folding shutters	X.	*South Court*	302
Fossil marbles	I.	*Eastern Annex*	15
Freestone	I.	*Eastern Annex*	35
Galvanized iron	XXXI.	*South Court*	434
Garden rollers	IX.	*Eastern Annex*	214
Gas meters, fittings, &c.	XXXI.	*South Court*	447
Gas retorts, gasometers, &c.	X.	*South Court*	302
Gates, wire-netting, fencing, &c.	IX.	*Eastern Annex*	218
Goffering and crimping irons	XXXI.	*South Court*	445
Granite	I.	*Eastern Annex*	11

	CLASS.	SITUATION.	PAGE
Granite (polished)	Sub-Class X.c.	*Eastern Annex and Transept*	313
Graphite: Plumbago	Sub-Class II.B.	*Eastern Annex*	136
Grasses, &c.	III.	*Eastern Annex*	140
Grates and stoves	XXXI.	*South Court*	401
Green Sand	I.	*Eastern Annex*	35
Gutta-percha	IV.	*Eastern Annex*	165
Harbours and graving docks	X.	*South Court*	297
Harrows	IX.	*Eastern Annex*	194
Hat and umbrella stands	XXXI.	*South Court*	446
Hay-making machines	IX.	*Eastern Annex*	207
Hinges, bolts, locks, and keys	XXXI.	*South Court*	417
Hoes and rakes	IX.	*Eastern Annex*	195
Hoists and lifts	X.	*South Court*	306
Hops	III.	*Eastern Annex*	140
Horse and steam-thrashing machines	IX.	*Eastern Annex*	202
Horse gear	IX.	*Eastern Annex*	213
Horse-shoes	XXXI.	*South Court*	437
Horticultural houses and implements	IX.	*Eastern Annex*	214
Hydrants: Valves	XXXI.	*South Court*	436
Hydrated oxides of iron	I.	*Eastern Annex*	48
Hydraulic motor (turbines, &c.)	VII.	*Western Annex*	263
Hydraulic presses and lifting-jacks	VIII.	*Western Annex*	267
Hyposulphite of soda	II.	*Eastern Annex*	106
Ice-making machines	VIII.	*Western Annex*	269
Ice-making machines	XXXI.	*South Court*	425
Ice safes	XXXI.	*South Court*	425
India-rubber	IV.	*Eastern Annex*	163
Indigo	II.	*Eastern Annex*	122
Inlaying of hard stones and marbles	I.	*Eastern Annex*	17
Iodine, its salts	II.	*Eastern Annex*	99
Irish marbles and Serpentine	I.	*Eastern Annex*	20
IRON AND GENERAL HARDWARE	XXXI.	*South Court*	396
Iron ores	I.	*Eastern Annex*	42
Isinglass and gelatine	III.	*Eastern Annex*	148
Ivory	IV.	*Eastern Annex*	168
Kettles and coal scoops	XXXI.	*South Court*	445
Kitchen ranges and cooking apparatus	XXXI.	*South Court*	406
Knife, and boot and shoe cleaning machines	XXXI.	*South Court*	444

	CLASS.	SITUATION.	PAGE
Lac-dye	II.	*Eastern Annex*	121
Lead	I.	*Eastern Annex*	75
Leather and leather cloth	IV.	*Eastern Annex*	169
Leather scraping and rolling machines	VIII.	*Western Annex*	283
Leeswood cannel coal	I.	*Eastern Annex*	60
Life-boats, and life-saving apparatus	XII.	*South Court*	378
Lifts, cranes, jacks, and hoists, driven by steam, water, or hand power	VIII.	*Western Annex*	274
Lighthouse lamps	XII.	*S. Court & Nave*	377
Lighthouses, and lighthouse apparatus	XII.	*S. Court & Nave*	371
Limestone	Sub-Class X.c. & I.	*Eastern Transept and Annex*	320
Limestones—ordinary, hydraulic, lias, and other varieties	I.	*Eastern Annex*	38
List of carriages used in 1862	VI.	*South-East Court*	384
Locomotive engines for railways	V.	*Western and Eastern Annex*	224
Locomotive engines for roads (traction engines)	VIII.	*Eastern Annex*	229
Lucifer matches	Sub-Class II.B.	*Eastern Annex*	135
Machines for cleaning and separating grain	IX.	*Eastern Annex*	206
Machines employing magnets	VIII.	*Western Annex*	275
Machines for hulling or drawing clover and trefoil seed	IX.	*Eastern Annex*	206
Machine tools	Sub-Class VII.B.	*Western Annex*	240
Machines for raising water, &c.	VIII.	*Western Annex*	264
MACHINERY IN GENERAL	VIII.	*Western and Eastern Annex*	221
Malachite, or green carbonate of copper	I.	*Eastern Annex*	72
Malt	III.	*Eastern Annex*	139
Maps of the geological survey of the United Kingdom and sections	I.	*Eastern Annex*	93
MANUFACTURING MACHINES AND TOOLS	VII.	*Western and Eastern Annex*	221
Marble	Sub-Class X.c. & I.	*Eastern Transept and Annex*	324
Marbles (Devonshire)	I.	*Eastern Annex*	19
Marbles from the Isle of Man	I.	*Eastern Annex*	20

	CLASS.	SITUATION.	PAGE
Marine engines	VIII.	*Western Annex*	236
Mats and matting	IV.	*Eastern Annex*	171
Materials used in railway construction	V.	*Western and Eastern Annex*	226
Medals and coins	XXXI.	*South and Process Court*	446
Medical and pharmaceutical products	Sub-Class II.B.	*Eastern Annex*	130
Metropolitan main drainage	X.	*South Court*	296
MILITARY ENGINEERING, ARMOUR, AND ACCOUTREMENTS, ORDNANCE AND SMALL ARMS	XI.	*South Court*	339
Military engineering	XI.	*South Court*	354
Military ornaments	XXXI.	*South Court*	444
Military model of London and adjacent country	XI.	*South Court*	355
Millstone grit, and wrought millstones	I.	*Eastern Annex*	34
Mincing machines and mills	XXXI.	*South Court*	441
Mineral black paint	I.	*Eastern Annex*	62
Minerals from the Lead Hills in Lanarkshire	I.	*Eastern Annex*	9
Mineral paints	I.	*Eastern Annex*	84
Mineral products of the Isle of Wight	I.	*Eastern Annex*	80
MINING, QUARRYING, METALLURGY, AND MINERAL PRODUCTS	I.	*Eastern Annex*	5
Miscellanea	III.	*Eastern Annex*	149
Miscellaneous machinery	VIII.	*Western Annex*	285
Miscellaneous agricultural implements	IX.	*Eastern Annex*	219
Miscellaneous chemical manufactures	Sub-Class II.B.	*Eastern Annex*	135
Miscellaneous building objects	X.	*South Court*	311
Model of coal tip	I.	*Eastern Annex*	92
Models of docks and harbour entrance at Sunderland, and of Seaham Harbour	I.	*Eastern Annex*	89
Model of iron furnaces at the Ulverstone Ironworks	I.	*Eastern Annex*	87
Models of plan for ventilating collieries, and of conveyance of coal underground	I.	*Eastern Annex*	90
Models of ship-building with regard to men-of-war	XII.	*South Court*	357

	CLASS.	SITUATION.	PAGE
Models of some of the ships built by J. Scott Russell on the wave-line principle since 1851	XII.	*South Court*	365
Models of Shipley Colliery	I.	*Eastern Annex*	92
Model of the Upleatham ironstone mines	I.	*Eastern Annex*	64
Model of Williamson's system of colliery ventilation	I.	*Eastern Annex*	91
Moulding sand, &c	I.	*Eastern Annex*	32
Moulds	XXXI.	*South Court*	435
NAVAL ARCHITECTURE. SHIP'S TACKLE	XII.	*South Court*	357
Nitrate of lead	II.	*Eastern Annex*	112
Nitrate of potash	II.	*Eastern Annex*	108
Northern lighthouses	XII.	*South Court*	374
Nuts and seeds, and their uses	IV.	*Eastern Annex*	166
Objects shown for architectural beauty	Sub-Class X.c.	*Eastern Transept*	311
Ochre	I.	*Eastern Annex*	84
Oils	IV.	*Eastern Annex*	150
Oil-cake mills	IX.	*Eastern Annex*	211
Oil mills	VIII.	*Western Annex*	270
Omnibuses and cabriolets	VI.	*South East Court*	390
Oolites	I.	*Eastern Annex*	36
Ordnance	XI.	*South Court*	339
Ore-dressing machine	I.	*Eastern Annex*	85
Oxichloride of lead	II.	*Eastern Annex*	128
Paper machines	VII.	*Western Annex*	256
Parabolic reflectors	XII.	*South Court & Nave*	372
Paraffin	II.	*Eastern Annex*	117
Parkesine	IV.	*Eastern Annex*	161
Patent hoist governor	XXXI.	*South Court*	429
Patent sphereometers, for facilitating great circle sailing	XII.	*South Court*	370
Peat	I.	*Eastern Annex*	63
Peat fuel machine	VII.	*Western Annex*	262
Pepsine wine	Sub-Class II.B.	*Eastern Annex*	134
Perambulators, &c	VI.	*South East Court*	393
Perfumery	Sub-Class IV.D.	*Eastern Annex*	171
Phosphate of soda	II.	*Eastern Annex*	105
Phosphorus	II.	*Eastern Annex*	99

	CLASS.	SITUATION.	PAGE
Pickles and preserved fruits	III.	*Eastern Annex*	147
Pig iron and manufactured iron	I.	*Eastern Annex*	51
Pigments	II.	*Eastern Annex*	124
Pigments (black)	II.	*Eastern Annex*	129
Pillars, rails, gates, garden seats, staircases, and verandahs	XXXI.	*South Court*	399
Platinum and other precious metals, with their products	I.	*Eastern Annex*	21
Plumbing	XXXI.	*South Court*	446
Poncho mattresses	XII.	*South Court*	379
Poolvash marble	I.	*Eastern Annex*	20
Porcelain clay	I.	*Eastern Annex*	27
Portland stone	I.	*Eastern Annex*	37
Potash	II.	*Eastern Annex*	107
Potash, extracted from its sources in the primitive rocks	II.	*Eastern Annex*	109
Prepared fuels	I.	*Eastern Annex*	62
Preserved meats	III.	*Eastern Annex*	146
Preserved milk	III.	*Eastern Annex*	145
Presses and dies	XXXI.	*South Court*	446
Printing machines	VII.	*Western Annex and Process Court*	259
Projectiles not exhibited in connection with ordnance exhibitors	XI.	*South Court*	348
Propellers	XII.	*South Court*	368
Protector locks	XXXI.	*South Court*	420
Prussiates of potash	II.	*Eastern Annex*	109
Purbeck marble	I.	*Eastern Annex*	329
Railways	X.	*South Court*	290
Railway appliances	XXXI.	*South Court*	446
Railway carriages	V.	*Western and Eastern Annex*	226
RAILWAY PLANT, INCLUDING LOCOMOTIVE ENGINES AND CARRIAGES	V.	*Western and Eastern Annex*	221
Reaping and mowing machines	IX.	*Eastern Annex*	200
Red hematite	I.	*Eastern Annex*	43
Red oxide of copper	I.	*Eastern Annex*	72
Refined leads—white, red, and orange lead, and litharge	II.	*Eastern Annex*	126
Revolving lights	XII.	*South Court & Nave*	376
Rolled metals and general iron ware	XXXI.	*South Court*	433
Rollers and clod-crushers	IX.	*Eastern Annex*	193
Sack-lifters and elevators	IX.	*Eastern Annex*	205

	CLASS.	SITUATION.	PAGE
Safes, chests, and strong doors	XXXI.	*South Court*	417
Safety-cages, hoists, skips, &c.	I.	*Eastern Annex*	65
Safety-fuse and blasting cartridges	I.	*Eastern Annex*	67
Safety lamps	I.	*Eastern Annex*	65
Salt	I.	*Eastern Annex*	86
Sandstone	Sub-Class X.c. & I.	*Eastern Transept and Annex*	317
Sandstones, flags, &c.	I.	*Eastern Annex*	35
Salmon and trout flies	IV.	*Eastern Annex*	170
Santonin	Sub-Class II.B.	*Eastern Annex*	134
Separation of wolfram from tin ore	I.	*Eastern Annex*	70
Serpentine	I.	*Eastern Annex*	13
Serpentine	Sub-Class X.c. & I.	*Eastern Transept and Annex*	329
Sewing-machines	VII.	*Western Annex and Process Court*	254
Ship-building for purposes of commerce, and ships' tackle	XII.	*South Court*	364
Ship-building for vessels of war	XII.	*South Court*	357
Ship's tackle, rigging, &c.	XII.	*South Court*	369
Shot, shell, fuzes, &c., manufactured in the royal laboratories, Woolwich	XI.	*South Court*	348
Silicate of soda	II.	*Eastern Annex*	106
Size, glue, gelatine, and starch	IV.	*Eastern Annex*	169
Skin	IV.	*Eastern Annex*	169
Slate	Sub-Class X.c.	*Eastern Transept and Annex*	314
Slates and slabs	I.	*Eastern Annex*	39
Small arms	XI.	*South Court*	352
Soap	IV.	*Eastern Annex*	156
Sodium	II.	*Eastern Annex*	106
Sowing machines and drills	IX.	*Eastern Annex*	197
Spathose ore, or sparry carbonate of iron	I.	*Eastern Annex*	46
Spermaceti	IV.	*Eastern Annex*	151
Sphereometers	XII.	*South Court*	370
Spinning machinery	VII.	*Western Annex*	246
Spirit levels for draining	IX.	*Eastern Annex*	217
Splint or hard coal	I.	*Eastern Annex*	59
Stable fittings	XXXI.	*South Court*	440
Stannate of soda	II.	*Eastern Annex*	105
Stationary engines	VIII.	*Western and Eastern Annex*	234

	CLASS.	SITUATION.	PAGE
Starch	Sub-Class II.B.	Eastern Annex	136
Steam hammers	Sub-Class VII.B.	Western Annex	242
Steam and horse ploughs and cultivators	IX.	Eastern Annex	185
Steam ploughs	IX.	Eastern Annex	190
Stearic acid and stearine	IV.	Eastern Annex	153
Steel	I.	Eastern Annex	56
Stevenson's lights	XII.	South Court	373
Stourbridge clay	I.	Eastern Annex	28
SUBSTANCES USED AS FOOD	III.	Eastern Annex	138
Sugar	III.	Eastern Annex	145
Sugar mills and vacuum pans	VIII.	Western Annex	270
Sundry colours	II.	Eastern Annex	125
Sundry manufactures in tin, lead, and zinc	XXXI.	South Court	416
Sundry maps and mining plans	I.	Eastern Annex	95
Sulphate of copper	II.	Eastern Annex	112
Sulphide of copper	I.	Eastern Annex	72
Sulphuric and other acids	II.	Eastern Annex	97
Sulphurous saponification	IV.	Eastern Annex	155
Syrup of iodide of iron, &c.	Sub-Class II.B.	Eastern Annex	134
Tanks and cisterns	XXXI.	South Court	415
Tea	III.	Eastern Annex	142
Tea-urns	XXXI.	South Court	435
Teignmouth pipe, or potter's clay	I.	Eastern Annex	30
Tin	I.	Eastern Annex	69
Tinned, enamelled, and Japan ware, inlaid and gilt ornaments	XXXI.	South Court	422
Tobacco and snuff	III.	Eastern Annex	149
Traction engines	VIII.	Eastern Annex	220
Traps	XXXI.	South Court	443
Troop ship for the Lower Indus	XII.	South Court	360
Troughs and food machinery	IX.	Eastern Annex	213
Tungstate of soda	II.	Eastern Annex	105
Tungsten colours	II.	Eastern Annex	129
Turning	IV.	Eastern Annex	170
Type-casting and composing machines	VII.	Western Annex and Process Court	258
Type-founding machinery	VII.	Western Annex	257
Ultramarine	II.	Eastern Annex	124
Vanes and weathercocks	XXXI.	South Court	446
Varnishes	II.	Eastern Annex	129

	CLASS.	SITUATION.	PAGE
Vegetable fibres	IV.	*Eastern Annex*	162
Ventilating furnace	I.	*Eastern Annex*	90
Walker's ship log and sounding machine	XII.	*South Court*	382
Warming and ventilating	X.	*South Court*	304
Washing machines	VIII.	*Western Annex*	282
Water-pressure cranes	VIII.	*Western Annex*	266
Water machines for raising	VIII.	*Western Annex*	264
Wax, and wax flowers and figures	IV.	*Eastern Annex*	170
Weaving machinery	VII.	*Western Annex*	250
Weston's new patent differential pulley blocks	IX.	*Eastern Annex*	217
Wheat, and other cereals	III.	*Eastern Annex*	138
White lead	I.	*Eastern Annex*	78
Whites—lead, zinc, &c.	II.	*Eastern Annex*	126
Windows	X.	*South Court*	301
Wines, beer, and other drinks	III.	*Eastern Annex*	149
Wire, wire-work, and conductors	XXXI.	*South Court*	430
Wolfram	I.	*Eastern Annex*	70
Wood, plain and ornamental	IV	*Eastern Annex*	161
Wood-working machines	Sub-Class VII. B.	*Western Annex*	244
Wools	IV.	*Eastern Annex*	167

HANDBOOK

TO THE

INDUSTRIAL DEPARTMENT

OF THE

International Exhibition, 1862.

IN TEN PARTS.

By ROBERT HUNT, F.R.S., F.S.S.
KEEPER OF MINING RECORDS.

Published with the AUTHORITY OF HER MAJESTY'S COMMISSIONERS, *and*
Sold within the Building by their Sanction.

PART I.

CLASS I.—MINING, QUARRYING, METALLURGY, AND MINERAL PRODUCTS.

LONDON:
EDWARD STANFORD, 6 CHARING CROSS.

[*The Right of Translation is reserved.*]

"The end of our foundation (*Solomon's House*) is the knowledge of causes and secret motions of things, and the enlarging of the bounds of human empire to the effecting of all things possible."

BACON'S NEW ATLANTIS.

LONDON: PRINTED BY W. CLOWES AND SONS, STAMFORD STREET.

INTRODUCTION.

At the time of the Great Exhibition of 1851 it was felt that, in all divisions of that vast gathering, there were articles respecting which some special explanatory information was desired. I was asked on that occasion to endeavour to supply this want, and the result was the Handbook then produced.

That work being found useful, to those who desired to profit by a careful study of the accumulated treasures of human industry, it has been thought desirable to repeat the experiment. Therefore I have attempted again to furnish the public with a Handbook *to the Industrial Department of the* International Exhibition. In this work it is my purpose to place in the hands of the visitors concise descriptions of the articles exhibited—arranged, as far as possible, in groups, which may be easily referred to. I desire, within the limits allowed me, to comprehend the largest possible amount of special information; and thus, taking advantage of all the circumstances connected with this gathering of the Nations, to produce a work which shall have some value after the Exhibition has closed.

I have been greatly aided by the Exhibitors, who have furnished me with much valuable information respecting their manufactures. There are, however, a considerable number to whom it is necessary I should explain, that, having rigorously avoided all comments, either in praise or otherwise, they must not be disappointed in finding that the excellences to which they directed my attention have not been recorded.

The fulness—the perfection—of many parts of the Exhibition, and the really important matter with which I have been furnished, render it advisable that some *slight deviation* should be made from the original scheme, as published in my Prospectus. By this change the Exhibitors and the public will be equally the gainers.

The size of the completed Handbook will be increased without any advance in its price, and the information given will be less incomplete, than it would have been if the plan had been adhered to which was arranged ere yet the Exhibitors had opened out their treasures.

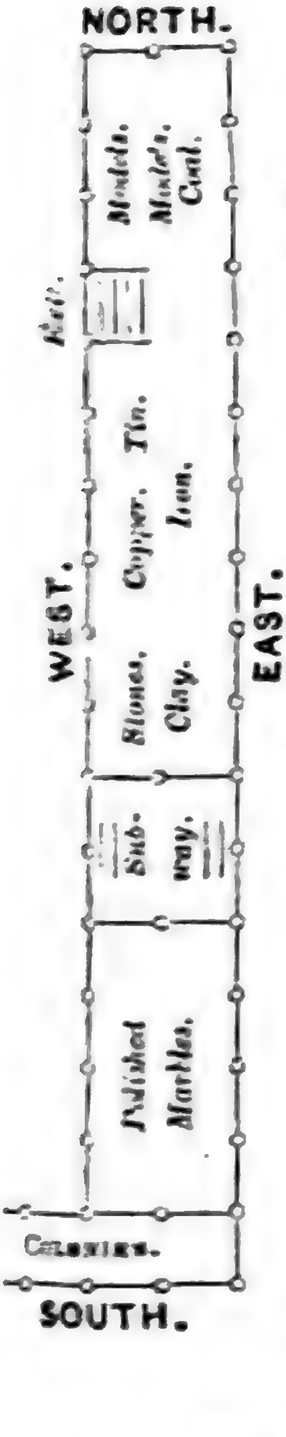
The present Part is, therefore, under the new arrangement, devoted to *Mining*, *Quarrying*, *Metallurgy*, *and Mineral Products*. Part II., which is nearly ready for publication, will embrace *Chemistry and Pharmacy*, *Food*, *Animal and Vegetable Substances*, *and Agricultural Machines;* the other Parts being but very little disturbed by this alteration.

ROBERT HUNT.

6, *Green's Row*, *Chelsea.*

INTERNATIONAL EXHIBITION, 1862.

CLASS I.—MINING, QUARRYING, METALLURGY, AND MINERAL PRODUCTS.



Number of Exhibitors, 435.

SITUATION OF CLASS.—*It commences at the North End of the Eastern Transept, following the Colonial Division; from this it is continued in the Eastern Annex, extending under and beyond the entrance to the Horticultural Gardens.*

Position of Groups.—Aluminium, British gold, and mineralogical specimens, next the Colonies. British marbles, and polished stones, between the entrance and the Horticultural Subway. Clays, building-stones, and millstones, under and extending beyond the Subway. Iron manufactures follow along the centre and chiefly on the Eastern Side of Annex. Copper, tin, zinc, and other metalliferous ores on the Western Side. Ore-dressing machine, safety-cages, &c., on Western Side. Model of ironworks, beyond entrance to Open Court. Models of coal-mines on either side.

IN THE OPEN COURT (*West*).

Granite drinking fountains, monuments, large slabs, gas-retorts, corrugated metal roofing, coals, iron ores, &c.

IN THE OPEN COURT (*North*).

Armour plates, Butterley rail, Rosedale magnetic iron ore.

ALUMINIUM.

Exhibitors.—Bell Brothers, Newcastle-on-Tyne (13).

This metal, of which some most beautiful examples meet the visitor before entering the Eastern Annex, is diffused throughout the rocks and sedimentary deposits of the Earth's surface, forming in combination with oxygen the earth alumina, which, in union with silica, gives rise to the almost endless varieties of clay, and is found nearly pure in the sapphire, the ruby, and in corundum.

Alumina was first decomposed by Sir Humphry Davy, who discovered this metal—Aluminium—soon after decomposing the other earths and alkalis; but he never seems to have obtained it without some mixture of Potassium. It is evident, however, that alumina was completely reduced to the metallic state by Davy.

Wöhler obtained aluminium pure in 1827, by the reduction of the chloride of aluminum in the form of a gray powder. Later (1845), he succeeded by the same process in obtaining it in globules, which he describes as tin white, tolerably malleable, and ductile, not materially oxidized by exposure to the air, of a specific gravity of 2·5, but, when hammered, of 2·67.

In 1854, Deville's first experiments on the preparation and properties of aluminium were published. The method he adopted for the liberation of the metal was essentially the same as that originally employed by Wöhler. But, by dint of improvements in the details of the process, he succeeded in procuring it in larger globules, which were silver white, having a fusing point nearly approaching that of silver, which were unoxidized when exposed to the air, even in a fused state, and remaining bright *even in boiling water*.

Deville's process of obtaining aluminium, which is practised by the exhibitors, is as follows:—

Having obtained the chloride of aluminium, he introduces into a wide glass (or porcelain) tube, 200 or 300 grammes (about 15½ grs. each) of this salt between two plugs of asbestos (or in a boat of porcelain, or even copper), allows a current of hydrogen to pass from the generator through a desiccating bottle containing sulphuric acid and tubes containing chloride of calcium, and finally through the tube containing the chloride; at the same time applying a gentle heat to the chloride, to drive off any free hydrochloric acid which might be formed by the action of the air upon it. He now introduces at the other extremity of the tube a porcelain boat containing sodium; and when the sodium is fused the chloride of aluminium is heated, until its vapour comes in contact with the fused sodium. A powerful reaction ensues, considerable heat is evolved, and by continuing to pass the vapour of the chloride over the sodium until the latter is all consumed, a mass is obtained in the boat of the double chloride of aluminium and sodium, in which globules of the newly-reduced metal are suspended. It is allowed to cool in the hydrogen, and then the mass is treated with water, in which the double chloride is soluble, the globules of metal being unacted upon.

In 1855 Mr. Allan Dick made the discovery, in Dr. Percy's laboratory, of the method of obtaining aluminium from kryolite, a mineral now found in considerable abundance in Greenland. Kryolite is a double fluoride of aluminium and sodium, analogous to the double chloride of aluminium and sodium. The process has the advantage that one of the materials is furnished ready formed by nature. Mr. Dick's process consisted in heating small pieces of sodium placed in alternate layers with powdered kryolite, in a platinum crucible, lined with magnesia.

The value of this metal for ornamental works is proved by the very difficult castings exhibited, which were run in one single piece; and when it is remembered that this substance is incorrodible and never blackens, even in the most impure atmosphere, there appears every reason to hope that before long it will find extensive employment in the manufactures of our country. Availing themselves of the lightness of aluminium, the exhibitors have constructed a sextant and some other instruments of a philosophical character.

The case contains also specimens of the double chloride of aluminium and sodium, from which the aluminium is obtained by fusion with Sodium, which latter metal as well as the former is exhibited in masses, indicative of being produced upon a scale of manufacturing importance. A very beautiful alloy is produced by the combination of aluminium with copper, a compound known as Aluminium Bronze. In colour and polish this substance closely resembles the finest gold, and at the same time it is not only capable of being cast in moulds, but also forged under the hammer like the softest iron, which metal in strength it far surpasses. Where beauty and great powers of endurance are required, aluminium and its alloy bids fair to meet with an extensive application.

BRITISH GOLD.

Exhibitors.—The Vigra and Clogau Mining Co. (383), T. Allison Readwin (295), G. V. Irving (166).

In 1844 Mr. Arthur Dean communicated to the British Association, meeting at York, a "*Notice respecting the Discovery of Gold ores in Merionethshire.*" The author stated that in 1843 he discovered some rich gold ores at the Cwmheisian Mines, near Dolgelly; and "that further researches proved that a complete system of auriferous veins exists throughout the whole of the Snowdonian or Lower Silurian formations of North Wales".—*See British Association Report for* 1844. Upon faith in this statement, much money was expended at Cwmheisian mines, and very good gold obtained. About ten years later large sums of money were expended, and but little of the precious metal returned. Dol-y-frwynog Mine was subsequently worked, and this proved also a failure. The examples now exhibited are from the Clogau mountains. The Clogau Mine, as it is called, is situated at an elevation of one thousand feet above the sea level. The "St. David," or "gold lode," is the most remarkable feature of the mine. This lode is at the junction of the Cambrian sandstones, and the Lingula Flags of the Lower Silurian rocks.

In 1861 Mr. Readwin brought the subject before the British Association at Manchester, and he then gave the following results of the actual working operations for gold from the beginning of the year:—

Tons.	wt.		Ounces.	Dwts.	
191	11	of the lode gave of gold	241	14	
12	17	,, ,,	96	0	
3	0	,, ,,	976	6	
207	8	from the bulk of the lode gave	1314	0	of fine gold.

"This," says Mr. Readwin, "is, I believe, the first public record of a hundred-weight of gold having been obtained from the Crown Lands of this country, the value of which is about 5,300*l.*"

This gentleman exhibits *specimens of auriferous ores from the Dolgelly district of Merionethshire, North Wales* (295), comprising native gold, associated with quartz, carbonate of lime, talcose schist, chlorite schist, clay-slate, barytes, silver, argentiferous galena, telluric-bismuth, graphic-tellurium, oxides of copper and iron, sulphides of iron, lead, copper, zinc, &c. These specimens illustrate very satisfactorily the geological peculiarities of this interesting district.

The published report of the directors of the Vigra and Clogau mines for 1861, give the returns for the year, from St. David's lode, as 2844 ounces of fine gold, and this rate of production is still continuing.

MINERALS FROM THE LEAD HILLS IN LANARKSHIRE.

Exhibitor.—**George Vere Irving (166).**

The minerals from Lead Hills are of much interest, from their mineralogical character.

In additition to the interest which attaches itself to many of the mineralogical specimens in the case exhibited, it has an historic value, as showing examples of the sources of much of the gold in the Scottish regalia.

It is not certain when the gold and lead mines of this district were first discovered: there is no doubt, however, that they are very ancient, for when the Celtic tribes occupied this district in the sixth and seventh centuries, they worked the gold, and used it to make their ornaments, and the collars and helmets of their chiefs. We have no record of a lead mine being worked until the year 1239, when one was sunk in Glengouar Water by the monks of Newbattle, who gained entire possession of all "the mines and lead-pit," in the year 1469, when it was granted to them by a charter of resignation from David, Earl of Crawford. After this it passed through several hands until its success attracted the notice of Mary of Lorraine, who, soon after she married the King of Scotland, procured, through her father, the services of a body of workmen from her own Duchy, which was the great mining district of France. Owing to their superior skill, so much gold was taken from the mines in 1542, that the Scottish regalia was made from it. After the accession of Elizabeth to the throne of England, Cornelius de Vos and some other London merchants went into Scotland to search for gold; they did not, however, succeed very well, being obliged to pay a heavy fine to the Regent Morton for being allowed to export the precious metal. After this the mines were worked by Bulmer, a speculative man, under whose hands they succeeded for a short time, until he joined in so many more speculations and wasted so much of the gold, that he also failed. Since this time search for gold seems to have been abandoned. During all this time the lead mines had been worked very successfully by Thomas Foulis and his descendants. Lead Hills produced, in 1860, 1,053 tons of lead ore.

CAIRNGORMS AND OTHER MINERALS FROM PORTSOY.

Exhibitor.—The Earl of Seafield (319).

The pellucid wine-coloured varieties of smoky quartz are called Cairngorm or Cairngorm stone, after the name of the mountain in Invernesshire where they are found. It is also common throughout the central group of the Grampian Hills; the crystals met with on the east side of Loch Avon being pale and very clear, while those from the west side are of a dark-brown colour. (See *Bristow's Glossary of Mineralogy.*) Nicholl says, "It was formerly much valued for ornamental purposes, and an Edinburgh lapidary cut nearly 400*l.* worth of jewelry out of a single crystal."

GRANITE.

Exhibitors.—**J. G. Adair (5), Cheesewring Granite Co. (58), W. and J. Freeman (110), W. H. Heaven (145), F. Hill (153), D. H. Newall (247), Ross of Mull Granite Co. (308), S. Trickett (372), J. Williamson (405), J. Wright and Sons (428), W. Sim (326), Macdonald (214), M. Teague (352), Wagstaff and Co. (386), F. Franklin (109).**

Physically, this rock consists, generally, of about 40 per cent. of felspar, 30 or 40 per cent. of quartz, and from 10 to 20 per cent. of mica.

The chemical composition of ordinary granite is usually as follows:—

Silica - - - -	72·3
Alumina - - -	15·3
Alkalis - - - -	7·4
Lime and magnesia and iron	5·0

In the West of England, the more important quarries worked for this durable stone are those of Lamorna, to the west of Penzance; the Penryn quarries; the Cheesewring, near Liskeard; the Fremator quarries, near Tavistock, and Pew-Tor, Heale, and Haytor on Dartmoor.

The following great works, amongst many others, have been constructed entirely, or in part, of such Cornish granites as those exhibited. The Penryn and Lamorna granites have supplied Waterloo Bridge; Portland Breakwater; Keyham Docks at Devonport; Commercial Docks, London; the Hull, Great Western, and Birkenhead Docks, and the National Works at Chatham and Portsmouth, together with the Scutari monument. The plinth for the railings of the British Museum was from the Carnsew quarries, Penryn, and the towers, including the lodge, from Constantine. The polished pedestals and pilasters exhibited are from the Penryn quarries.

The Cheesewring granite, from Cornwall, of which Mr. Bell's obelisk in the Nave is formed, has been used in the London Docks, Westminster Bridge, the Thames embankment, Rochester Bridge, the docks at Copenhagen, the Great Basses

Lighthouse near the Island of Ceylon, and for the tomb of the Duke of Wellington in the crypt of St. Paul's Cathedral. The black and red porphyritic granite used in this sarcophagus is from near Par in Cornwall.

Granite is now exhibited from Lundy Island. This granite is little known, therefore the following remarks by the exhibitor are of interest:—

"It should be borne in mind that, with the exception of No. 1, which was taken a few inches under the turf, all the specimens are mere surface stones, and have been exposed to atmospheric influences for perhaps hundreds or even thousands of years (yet they are sound and very hard). Much better are almost invariably found in depth in a *quarry* than on the surface, and any defects disappear. These specimens therefore should be considered as exhibited to show the *fineness* of the stone, not as the *best* of each sort, and yet they prove, what is very desirable to know, that they can withstand exposure."

The Granites of Scotland.—The granites of Aberdeen and Peterhead—of which many fine examples are exhibited, such as the obelisk by Mr. Sim, in the Nave, the productions by the Messrs. Macdonald, Wright and Son, and others—are extensively worked.

The granite of Aberdeen, especially from the quarries of Dancing Cairn, Rubislaw, and Tyrebagger, is much used in the metropolis for kerb and paving stones; some red granite is also quarried. Around Peterhead the red granite prevails, hence it is usually distinguished as the *Peterhead granite*. The principal quarries are those of Black Hill, four miles west of Peterhead, belonging to the Governors of the Merchant Maiden Hospital of Edinburgh; those on the estates of the Earl of Errol,—at Boddam,—at Longhaven,—at Cairngall and at Rova. The Stirling Hill quarries, at Boddam, furnished the pillar of the Duke of York's monument; the Seafield quarries, the abacus. The beautiful pillars in the library of the British Museum were obtained from Longhaven. The pillars in Fishmongers' Hall are from the Stirling quarries, as are also the bases of the monuments of Pitt and Fox. The polished pillars of the Carlton Club House, in Pall Mall, are from the quarries of Peterhead.

In addition to these, we have the granite from the Ross of Mull—from which island it was thought a monolith might have been obtained as a memorial to the Prince Consort—Mr. Sim's granite obelisk being from the same neighbourhood; and also from Dalbeattie.

The Granites of Ireland.—The most extensive granite district in Ireland stretches south from Dublin, through the counties of Wicklow and Carlow into Kilkenny; it occurs on the south-eastern coast of Down, and around Newry; the range of the Mourne mountains is granite, which again appears in small and isolated protrusions in Derry and Tyrone, and in Cavan. In the western portion of Donegal there is a large extent of this rock, which here partakes of a gneissose character; and again, in the west of Galway, granite covers a considerable area. Examples are sent by Mr. Adair. The granite of the Wicklow range varies in its quality; that near Kingston being coarse and hard, while that from Ballyknocken, or Golden Hill, is much finer, and therefore fitted for ornamental work. The granite of Down is of a darker colour, and finely crystallized. It is extensively quarried at Newry, and sent by water to the north of Ireland.

The Galway granite is of a reddish colour, containing large crystals of flesh-red felspar (see Mr. Franklin's pedestal). That of Mayo is of a dark bluish-gray colour, while that of Tyrone is reddish.

SERPENTINE.

Exhibitors.—**Lizard Serpentine Co. (213), Serpentine Marble Co. J. Murphy (242), Earl of Seafield (319), W. Pearce, jun. (269).**

Serpentine is a hydrated silicitate of magnesia, composed of silica 43·64, magnesia 43·35, water 13·01 = 100. Its colour is green and red, seldom of an uniform tint, but generally of several shades arranged in dotted, striped, and clouded delineations. For this reason it has received the name of Serpentine (or ophiolite, from ophis, *a serpent*, and lithos, *stone*), from the fancied resemblance which it bears to the skin of a serpent, both in colour and in its spotted or mottled arrangement. It is slightly unctuous to the touch, sectile, and tough; and therefore easily cut into ornamental forms. It has been divided into precious or noble serpentine and the opaque varieties, forming extensive rock masses, especially at the Lizard in Cornwall, in Anglesea, Portsoy in Banffshire, Unst and Fetlar in Shetland.

Serpentine may be turned in the lathe, takes a good polish, and forms a very beautiful, not brittle, ornamental stone, which withstands atmospheric influences remarkably well.

Serpentine is manufactured into a variety of articles; and within the last few years extensive works have been established in Cornwall, where, by means of powerful machinery, it is made into columns, vases, chimney-pieces, and other ornamental articles, such as are exhibited. This is, beyond all question, the most beautiful of the ornamental stones of this country. The serpentine of Portsoy, in Lord Seafield's Case, is also a very interesting stone. It was formerly exported for manufacture. (See *Irish Marbles.*)

DERBYSHIRE MARBLES.

Exhibitors.—E. Bird (26), S. Bright and Co. (37), J. and T. Hall (133), J. Lomas and Sons, and S. Birley (206), S. Smith (333), A. Tomlinson (367), J. Turner (379), T. Woodruff (426).

The Derbyshire works are grouped in the court leading from the Colonial department into the Annex.

The limestone rocks of Derbyshire are divided into four classes, known as the 1st, 2nd, 3rd, and fourth limestones, which are separated from each other by the *toad-stone*, an amygdaloidal trap rock. The ornamental marbles are, however, mostly confined to the first three formations.

The rocks of Derbyshire are rich in ornamental marbles, of which the principal varieties are exhibited. From their beauty, and in many respects, their curious character, these marbles have been largely employed for decorative purposes. They are usually distinguished by their colour—as white, gray, dove, blue, black, and russet marbles, or by physical peculiarities, depending mostly on their fossil contents, as bird's-eye, dog-tooth or muscle, entrochal, shelly, and breccia marbles.

Many of these marbles are built up of the stony fragments of the great group *Crinoidea*,—belonging to the class *Echinodermata*,—a proof of the teeming abundance of the ancient seas with these forms of life. These, from their resemblance to plants, are called *stone-lilies* (*Encrinites*). Mr. Parkinson states that the upper part of the skeleton of one species of encrinite consisted of nearly 27,000 ossicles or small bones. These being dislocated are cemented together, in the marbles, by carbonate of lime; and being, in the process of manufacture, cut in many different sections and polished, they assume a variety of forms. The name of *wheel-stone* (*Entrochite*) is given to these broken stems of the fossil encrinites; and when united so as to form a column, the series is termed an Entrochite: hence these rocks are known as entrochal marble.

Many of the examples of Derbyshire manufacture exhibited merit close attention. The Florentine work, as it is called, which is almost confined to Derbyshire, is remarkable for fineness of execution and beauty of design. I have been favoured with the following notices of these Derbyshire manufactures, which, from their descriptive character, will be acceptable to the visitor.

"Machinery for cutting and polishing these marbles was first used in the year 1748, at the village of Ashford, on the river Wye, about two miles above Bakewell. Quarries of the well-known black marble are in the immediate vicinity of these works. The manufacture by machinery was afterwards extended to other places in the county; and there are now establishments for making chimney-pieces, columns, &c., at Bakewell, at Buckland Hollow, near Amber-Gate station, on the Midland Railway, and at Derby; besides two at

Ashford. Besides the black marble quarries near the village, there are quarries of other marble near Merryash; in the valley of the Wye at Litton Dale; near Wirksworth; and in several other localities. The beds of black marble are thin, and seldom exceed seven or eight inches. It is susceptible of high polish; but, at present, it is difficult to obtain it of any considerable surface free from "shakes," or from small veins of white spar.

A brown marble, in thin bands of various depth of colour, presents, when cut and polished, something of the appearance of rosewood; which name has been given to it in consequence. The best quality is in a bed of not more than three or four inches thick. It is close in texture; takes a high polish; and is the hardest and most durable of the Derbyshire marbles.

A red marble, having much of the character of the "rosso antico," is found, chiefly near Newhaven, in irregular lumps of no great size, and is used only for small vases, and other ornamental purposes.

On the borders of Derbyshire and Staffordshire, marble has been quarried which presents a variety of colours, some of them of considerable beauty; but this marble is so liable to flaw, that its use is restricted to the smaller pieces of good colour, for vases, or inlaying.

The other marbles are grey or brown, from light grey to nearly black; and are found in blocks of considerable size and thickness; but a frequent want of closeness of texture causes a considerable waste in the manufacture. The patterns of these marbles are due to the fossils contained in them, chiefly encrinites, and in some varieties corals.

The black marble is used to some extent for the manufacture of vases, and other ornamental objects; and also for the tops of tables which are inlaid in designs, partly copied from the Florentine work, but sometimes having a geometric character. This process of inlaying, has been in existence for about thirty years, and is used to a considerable extent. Besides the manufactures in marble, there has been for many years, in Derbyshire, a manufacture of various ornaments in the fluor spars of the county; of which the blue fluor is the most celebrated. The best qualities of this have become scarce.

INLAYING OF HARD STONES AND MARBLES.

One of the best-known ornamental uses of hard stones and marbles, and other natural substances of like nature, and susceptible of being polished, is the practice of inlaying. Under this term, which, in strictness, would be confined to the introduction of one substance into another, which proves a sort of groundwork for it, is included a process which would more accurately be called veneering, in which the various stones used are placed, one against another, on a bed of stone or metal. Sometimes both processes are employed in the same piece of work.

The most celebrated, and the most beautiful of these manufactures, is the Florentine inlaid work in "pietra dura," of hard stones and gems. In this work the stones are let into a ground of black marble, which is cut to less than one-eighth of an inch in thickness; the black marble is entirely cut away from the parts where the coloured design is to be shown. The coloured stones are cut of nearly the thickness of the black marble, and of the shapes requisite for the different forms and colours of the design; and the whole is cemented into a bed of marble or slate of the strength required. The stones employed for this work are jasper, agates, chalcedony, and others of great hardness, mixed with a few softer stones, as lapis lazuli, &c., where peculiar colours are required. There is a brilliancy and lustre about this work unequalled by any other; but it is necessarily too expensive to be extensively employed. A cheaper, and less brilliant, but still very beautiful inlaid work, termed "Pietre commesse," is executed at Florence in coloured pebbles, and marble, intermixed with a few of the harder stones and a species of shell. The best Florentine work is distinguished by great accuracy of workmanship, as well as by the graceful arrangement of the flowers and the delicacy of the shading.

In England, in Derbyshire and in Devonshire, much inlaid work has been done. In the former county, inlaying has been practised for about thirty years, exhibiting a great variety in the nature of both work and design. Part of it imitates the character of the Florentine work, in inlaid groups of flowers. In the inlaid work, properly so called, a piece of black marble is selected, of the thickness of the table top, or other article intended to be inlaid. The outline of the coloured design is marked on the table, and the marble within that outline is cut away to the depth requisite to receive the piece of coloured marble, or other analogous material, intended to be inserted. An example of this is shown. This method has the advantage of great solidity; and the result shows that it is capable of great exactness of workmanship.

In Devonshire the process employed is usually that of veneering; the rocks of that county furnish the inlayers with a material of great beauty, and the accuracy of the joinings is remarkable, in the best work.

Some extremely beautiful specimens of inlaying have been brought from India, done in hard stones, in a ground of white marble. The stems of the design are very thin; the small leaves and flowers are conventional. There is a singular delicacy of design, and wonderful skill in the execution.

Malachite, when covering large surfaces, is always veneered. The pieces used are cut large; but great ingenuity is frequently shown in arranging them so as to produce an appropriate design.

The art of inlaying is more or less practised in various countries; but the methods adopted present no remarkable variety. Some of the Derbyshire tables now exhibited are equal to anything which has ever been executed.

Amongst other things in this collection, a pair of bell-shaped vases, cut out of black marble from the Duke of Devonshire's quarries, should be examined. They are 36 inches high, 22 inches diameter. The great feature of this pair of vases is their remarkable size, and the *purity*, *colour*, and *high polish* of the marble, being quite *free from blemish*. It is particularly to be noticed that the handles and the *gadroned* body of the vases are cut of a solid block.

Also a tazza of black marble, 29 inches high, 27 inches diameter, the purity and fine colour of which will be admired; the handles and the gadrone body are, like the bell vases named above, cut out of one solid block.

In front of this tazza will be found a casket, also in black marble, inlaid; a grouping of flowers on the lid, as well as round the sides and ends; the *stems* of the flowers are *all stone, not filled in* with *cement.*

The term "gadroned," sometimes spelt "gotharooned," is applied here to the "beading" (the exact reverse of fluting—the relievo instead of the intaglio), which is often used on the swelling part of vases, below the principal bell.

DEVONSHIRE MARBLES.

Exhibitors.—**J. C. Stark (340), A. Batson (15), W. Denby (84), Serpentine Marble Co. (437).**

The limestone formation of Devonshire, for all useful purposes, may be said to be confined to the neighbourhoods of Torquay and Plymouth—the Babbacome limestone, yielding some interesting varieties of the red-grey and variegated marbles. Many blocks are almost entirely formed of *fossil corals*; these are known as *madrepore marbles*, and some curious red and yellow kinds are met with, but in small quantities.

At Ipplepen there is an extremely handsome variety of a reddish marble, and some of a nearly similar character occurs near Totness. The limestones of Plymouth are not generally so handsome as those of Babbacome, but many very fine examples may be obtained. Throughout the limestone formations between Newton Bushell, Babbacombe, and Plymouth, marbles of very great varieties of colour may be obtained, as Mr. Batson's inlaid table shows. The ordinary character of the marbles is better seen in the chimney-pieces exhibited by J. C. Stark, the marble slabs which adorn the walls, and the pedestals below them.

MARBLES FROM THE ISLE OF MAN.

Exhibitor.—T. Quilliam (290).

The principal rock of this island is a clay slate, to which all the inhabitants have by law free access for their own use, and with which nearly all the buildings in the island have been erected. In the immediate vicinity of Peel the Old Red Sandstone appears, which is used for construction in that district; and at Castletown and the neighbourhood, the rock is a hard blue limestone, also subject to the same uses. There are two quarries let on lease by the Crown, where it is quite black, and takes a good polish, but it cannot be obtained at a price to compete with English marbles, and the revenue to the Crown is very small. In two places in the interior of the island the granite crops up, but though of a fair description it has never got into the English market.

In St. Paul's Cathedral some of the Poolvash black marble was used, and many of the varieties are employed, but not in large quantities, in ornamental works.

IRISH MARBLES AND SERPENTINE.

Exhibitors.—**J. G. Adair (5), F. Franklin (109), Law Life Assurance Society (193).**

Ireland is rich in marbles. Her limestone formations extend over a central plain, 120 miles east and west from Dublin to Galway Bay, and about the same distance north and south, their greatest elevation being about 300 feet. The more valuable quarries are in the counties of Kilkenny, Carlow, Galway, and Mayo; from these several varieties of marble are raised, especially the black marble, next to which in importance are the dove, mottled grey, and white marbles. The Galway marbles are well known, but the beds in the quarries are usually thin, and there are but few of them which are fit for working; still fine blocks can be raised. It is quarried principally at Menlo, on the banks of Lough Corrib, the cost of obtaining it being greatly increased from the difficulty of getting rid of the water which flows into the quarries from the lake, the beds being near the surface level. (See the slab of black marble in the open Court.)

Under the head of Marbles we find the Serpentine rocks frequently included. These, however, differ widely from the limestone rocks, being compounds of silica and magnesia (see *Serpentine*), with adventitious admixtures of alumina, iron, and other substances. The west of Mayo and Galway are remarkable for their Serpentine rocks, which afford beautiful variegated green and white specimens.

This green Connemara marble, as it is usually called, of which two large blocks are shown in the court, is obtained at Ballinahinch, in Galway; the most valuable quarries are situated near Clifden, from which this beautiful material is largely exported.

The principal quarries for marbles are the following :—

Black Marble—Kilkenny ,Galway, Churchtown, Doneraile, Kerry, Tipperary.

White Marble—Connemara, Donegal, Churchtown, Kerry.

Coloured Marbles : these are scattered over all the districts in which the limestone occur.

PLATINUM AND OTHER PRECIOUS METALS, WITH THEIR PRODUCTS.

Exhibitors.—Messrs. Johnson, Matthey, and Co. (171).

On the stairs, as we pass into the Eastern Annex, are two Cases. One of these is devoted to the display of the precious metals—and the other to nickel and cobalt—with examples of the alloy called German silver.

Platinum was discovered by Ulloa, in 1735, but it was first rendered available by Dr. Wollaston. The largest supply of the metals, platinum, palladium, iridium, rhodium, and uranium, is obtained from the Uralian mountains ; some is procured from the alluvial deposits of Brazil, and other parts of South America.

The interesting character of this Case induces me to give the information with which I have been kindly favoured by the exhibitors. The articles exhibited are as follow :—

Ingot of pure Platinum, melted by the intense heat of combined gases (oxygen and nitrogen); weight 3,200 troy ounces (about 230 lbs.); value 3,840*l*.

No heat attainable by the use of fuel will melt platinum—hence its high chemical value. Even the heat of glass-house furnaces has no effect upon it; but by the new process perfected by M. St. Claire Deville, and carried out in England by Messrs. Johnson, Matthey, and Co., viz.: the heat of combined gases under great pressure, it can be melted like silver.

Platinum Boiler—patented—of novel design and construction. Its chief use is the concentration or rectification of sulphuric acid; value 465*l*. (without the pyrometer). The important points of improvement are facility and rapidity in use—comparatively small quantity of precious metal used in its manufacture, and great safety and economy in working.

Platinum Alembic—for the refining and separation of the precious metals; value 250*l*. That portion of the alembic which is subject to the greatest heat, wear, and strain, is made of strong metal, the other portion being correspondingly light in substance, which causes a great saving in expense without detriment to the working power.

Platinum Tubes—soldered with pure platinum. These are made of any size, length, or thickness. These tubes are superior to those soldered with gold, inasmuch as they are of one uniform metal—the joints being imperceptible—and superior to and lighter than those made by pressure, inasmuch as the metal is not subjected to the severe strain which pressed tubes have to undergo.

Platinum Pyrometer to be applied to boilers used for the rectification of acids, and for general purposes—being an "indicator" which acts by the variation of heat, at which each different strength of acid boils. It is a novel application of a compound lamina of two metals of unequal expansion by heat.

Platinum Spheres, Crucibles.—Basins, capsules, and chemical vessels—made of either pure or alloyed platinum—of various sizes and shapes; value 27*s*. to 30*s*. per ounce.

Platinum Wire and Foil, used for chemical purposes, galvanic batteries, dentists' materials, gunsmiths', philosophical instruments, &c., &c.; value 27*s*. to 30*s*. per ounce.

Platinum crucibles lined with gold for laboratory uses; platinum plated upon silver and upon copper; platinum in its native state; sponge; cover for tops of lightning conductors; preparations and compound salts.—Total value of platinum exhibited, 4,980*l*.

Palladium.—This metal occurs in small quantities in nature, associated with native gold and platinum. It is sometimes used instead of silver for the graduated scales of philosophical instruments, since it is not tarnished by sulphuretted hydrogen. An alloy of palladium with one-tenth silver is employed by dentists. Foil, sponge, and some palladium salts are exhibited. These vary in value from 8*l*. 8*s*. to 10*l*. 10*s*. per oz.

Pure Gold in four states of preparation, viz.:—

Granulated gold **Yellow ,,**	**for the use of goldsmiths, jewellers, &c.**
Brown ,, **Powder ,,**	**for gilding china, porcelain, and glass.**

Chloride of Gold—non-deliquescent—used in photography for imparting the delicate tones to the prints.

Crucible—for laboratory uses.

Gold in its native state; value exhibited 165*l*.

French needles for the use of travelling jewellers and others resident abroad, to determine within one-half carat the quantity and value of alloys of gold, are exhibited.

Purple of Cassius is associated with these. This beautiful preparation is a compound of one equivalent of gold with two equivalents of the binoxide of tin. It is employed to impart a red colour to glass and porcelain.

Silver, and some of its preparations will be found in this series.

Amongst the most remarkable objects in this Exhibition must be classed the metals of great rarity and value, exhibited here in the metallic state and in various combinations. These are—

Iridium.—This metal has received its name in consequence of the various colours of its compounds. It occurs in native platinum generally in combination with osmium. We find in works on chemistry it is generally stated that iridium has not been fused. The Case of Johnson and Matthey contains an ingot of pure melted iridium ; also the native alloy, containing the metals iridium, rhodium, osmium, ruthenium, &c. There is also pure sponge iridium, and the oxide and ammonia chloride of this metal, together with pure iridium and osmium melted together for the manufacture of points to gold pens, the value of which is 6*l.* 6*s.* per ounce. The iridium exhibited is valued at 251*l.*

Rhodium.—This metal is found associated with platinum in nature. It is one of the most infusible of metals, no heat but that of the oxyhydrogen blowpipe-flame affecting it. It derives its name from the beautiful rose colour of the solutions of its salts.

Osmium.—This metal is also usually associated with platinum, and in combination with iridium as *osm-iridium.* The "native alloy," which is exhibited.

Ruthenium is another metal of the same series. These metals are almost always associated with platinum, and the close relations existing between that metal, iridium and osmium, appear to indicate some yet closer affinities. The same may be said of rhodium, palladium, and ruthenium.

The oxide of Uranium is employed for producing that canary-yellow glass which is now used for ornamental purposes.

Silicon, or *silicium*, and *boron*, are bodies of the most extreme interest. The former being the elementary base of flint, sands, sand-stone, and quartz-rock ; while the latter of boracic acid. The discovery of silicium was made by Berzelius in 1823 ; that of boron, in 1702, by Homberg. These bodies are not regarded as metallic by chemists ; they exhibit a great similarity to carbon. Probably the researches of the experimental philosopher may show us that these bodies have some very intimate relation.

The total value of the metals and preparations exhibited in this Case is above 5,500*l.*

COBALT AND NICKEL.

Exhibitors.—Evans and Askin (100). Swansea Local Committee (346).

Cobalt and nickel ores are found in Cornwall, in Cumberland, and in Scotland. Cobalt was formerly raised at Huel Sparnon, near Redruth, and it is discovered at some other mines in that neighbourhood. At Dolcoath near Camborne it has been raised, and fine specimens are still to be found on the heaps, "*deads*," of the mine; it is also discovered in St. Just, to the west of Penzance, and has recently been sold from the St. Austle Consols. At Coniston, in Cumberland, specimens of cobalt occur; and from the property of the Duke of Argyll, in Argyllshire, nickelliferous pyrites in some quantity has been raised during the last two years. In 1855 the St. Austle Consols sold 39 tons of nickel and cobalt ore, and in that and the previous year about 300 tons nickel ore were raised in Scotland. In 1860 the total produce of our mines was under seven tons. Two varieties of cobalt—*smaltine*, or tin-white cobalt, and *cobaltine*, or silver-white cobalt, the former containing about 74 of arsenic to 20 of cobalt, and the latter about 49 of arsenic to 36 of cobalt, are the ores from which the greatest part of metallic cobalt is obtained.

Nickel is also found associated with arsenic, the *white nickel* and the *copper nickel* giving, by analyses—

Arsenic – – – –	72·64	46·62
Nickel – – – –	20·74	48·9
Cobalt – – – –	3·37	—
Iron – – – –	3·25	0·34
Sulphur – – – –	—	0·80

Nickel is a greyish-white metal possessing magnetic properties. The metallurgy of nickel is kept as secret as possible by the manufacturers. It is however produced in large quantities to meet the demands of the makers of German silver. The best German silver is said to be composed of copper 8 parts, nickel 3 parts, and zinc 3½ parts. A common variety is made of 8 parts of copper, 2 parts of nickel, and 4 parts of zinc. Several white metals bearing different names, such as nickel silver, albata plate, &c., are only varieties of the German silver.

CLAYS.

PORCELAIN CLAY.

Exhibitors.—W. Browne, St. Austell (42), Cannamanning China Clay Co. (54), F. Hill (153), Truscott and Co., St. Austell (375), S. Michell (227), E. Martin and Sons (219), R. Martin (220), Lee Moor Porcelain Clay Co. (195), P. Wheeler and Co. (399).

TEIGNMOUTH CLAY.

Exhibitors.—Devon and Courtenay Clay Co. (86), E. Blake, Newton Abbot (120), North Gunbarrow Co. (252), Whiteway and Co. (401).

POOLE CLAY.

Exhibitors.—T. Phippard (276), W. and J. Pike, Wareham (277).

STOURBRIDGE AND OTHER FIRE CLAYS.

Exhibitors.—Farnley Iron Co. (101), J. Hall and Co. (134), Harper and Moores (139), General Mining Co. of Ireland (115), King, Brothers (187), Perrens and Harrison (273), G. H. Ramsay and Sons, Newcastle (291).

OTHER CLAYS.

Exhibitors.—Fayle and Co., London (102), B. Barrow (13), Hon. J. Howard (159), Tavistock Committee (349).

Under each of those heads the varieties of clays shown will be briefly described. Brogniart has classified the varieties of clays into—

1. *Fire-proof*—embracing all the least fusible varieties.
2. *Fusible*—as the ordinary clays.
3. *Calcareous*—such clays as effervesce with acids, from containing earthy carbonates.
4. *Ferruginous*—or ochry clays, which are all coloured by oxide of iron.

The less fusible clays contain large proportions of silica and alumina, with but little lime, magnesia, iron, and alkalis; while the fusible clays contain these latter substances in notable quantities.

I estimated the value of clays produced in England and Wales, and clay manufactures in 1860, for the previous years, as follows:—

	£.
Clays and brick earth, unmanufactured -	285,846
Clay manufactures - - - - -	2,911,980

Porcelain Clay.—The porcelain clay of this country is obtained from the granite formations of Cornwall, and of Dartmoor in Devonshire. It was discovered by Mr. Cookworthy of Plymouth, in 1755, who established a pottery in Plymouth, which was subsequently removed to Bristol.

The china clay formations are usually thought to be granitic masses, rich in felspar, which have undergone decomposition. The clay is, however, often found at such a depth from the surface as to render it doubtful whether this is a true explanation.

The clay when first raised has the appearance and consistence of mortar; it contains numerous grains of quartz, and of mica, which are disseminated throughout in the same manner as in granite. In some parts the clay is stained of a rusty colour, from the presence of veins and imbedded portions of shorl and quartz; these are called by the workmen *weed*, *caple*, and *shell*, and are carefully separated. The clay is next conveyed to the floor of the washing-place, and is then ready for the first operation of the process.

A heap of the clay being placed on an inclined platform, on which a little stream of water falls from the height of about six feet, the workman constantly moves it and turns it over with a *piggle* and shovel, by which means the whole is gradually carried down into an oblong trench beneath, which is also inclined, and which ends in a covered channel that leads to the *catch-pits*. In the trench the grains of quartz and mica are deposited, but the other parts, in consequence of their greater levity, are carried onward in a state of suspension.

This water is conducted into a series of pits, lined on the sides and bottom with cut moorstone, laid in a waterproof cement. In these pits the coarser matters are gradually deposited. In the first pit the grosser particles collect; and being of a mixed nature, are always rejected at the end of each day's work by an opening provided for that purpose at the bottom of the pit. When the water has filled the first pit, it overflows into the second, and in like manner into the third; and in these pits, particularly in the second, a deposit also takes place, which is principally *mica*. The water, still holding in suspension the finer and purer particles of porcelain clay, next overflows into larger pits, called *ponds*, which are of the same depth as the first pits, but about three times as long and wide. Here the clay is gradually deposited, and the clear supernatant water is from time to time discharged by plug-holes on one side of the pond. This process is continued until, by successive accumulations, the ponds are filled. At this stage the clay is in the state of a thick paste; and to complete the process it only remains to be consolidated by drying, when it is fit for the market.

At the Lee Moor works, much of this is effected by machinery, and the drying is facilitated by artificial heat.

Of porcelain clay, there is produced annually in this country—

	Tons.
In Cornwall - - -	83,000
In Devonshire - - -	5,000

Porcelain clay is not only used in the manufacture of china; it is largely employed by the paper-makers, and by the calico-bleachers.

STOURBRIDGE CLAY (*Fire Clay*).—This fire clay is derived from the coal measures. Its great advantages are its infusibility, which depends of course on its composition. The composition, however, of these clays differs considerably.

The Stourbridge fire clays are exhibited of different kinds, viz., white clay used in making glass-house pots, &c., and black clay used in making crucibles for steel, iron, brass, &c.

The same clays manufactured into fire bricks for iron and other smelting furnaces, glass house pots and bricks, crucibles, gas retorts, are exhibited, including Walcott's patent retorts, which are in the Open Court.

The following analyses, showing the variations in the proportions of the constituents of the fire clays, are No. 1 in the dry state, No. 2 in the ordinary state, by Mr. C. Cowper; No. 3 by the late T. H. Henry; No. 4 is a clay from Tamworth, and No. 5 from the neighbourhood of Sheffield.

	1	2	3	4	5
Silica – – – – –	70·6	63·3	51·80	56·26	48·04
Alumina – – – –	25·9	23·3	30·40	32·59	34·47
Potash – – – – –	..	..	..	2·32	1·24
Oxide of iron – –	2·0	1·8	4·14	3·52	3·05
Carbonate of lime –	1·5	1·3	..	0·36	0·66
Carbonate of magnesia	trace	trace	·50	0·44	0·45
Water – – – – –	..	10·3	13·11	9·69	11·15

Varieties of each of these clays are exhibited, and their physical peculiarities can be studied.

Clays of a similar character to this are obtained from the coal measures of each of our great coal fields. These vary much in character and colour. Many of them are used for earthenware; others for fire-bricks, glass-house pots, crucibles, &c., while others are only fitted for sewage and drain-pipes, ordinary bricks, and the like.

POOLE CLAY, OR POTTER'S CLAY.—This is the Plastic Clay of geologists; it occurs in great quantities around Poole and Wareham, in Dorsetshire, at the base of the Bagshot beds. It is grey coloured, but becomes white in the potter's kiln; at which heat it is infusible. The Poole clay is very valuable to the potter, since from its refractory nature the ware formed from it will receive a harder glaze than ordinary, without suffering from the extreme heat.

The geological period during which this clay was formed is indicated by the vegetable remains found in it. These are parts of plants, such as palms, maples, and others belonging to such a climate as that of the Mediterranean Sea, and the North Coast of Africa.

The analysis of the Poole clay by Percy gives the following composition:—

Silica, 48·99; alumina, 32·11; potash, 3·31; lime, 0·43; magnesia, 0·22; oxide of iron, 2·34; water, 9·63.

The exportation by sea of the Poole clay has been as follows for the last five years :—

	Tons.
1857	58,840
1858	50,276
1859	65,676
1860	50,333
1861	56,462

and about 5,000 tons a year are sent from the neighbourhood by the railways. A quantity not less than 190,000 tons of this clay is employed in the locality in the manufacture of bricks, drain-pipes, stone-ware, pottery, and ornamental articles.

TEIGNMOUTH, PIPE, OR POTTER'S CLAY.—The clay which abounds in the neighbourhood of Newton Abbot in Devonshire, is, like the china clay, due to the decomposition of granite. Nature has, however, effected the work here instead of man.

It is evident, upon examination, that a current setting from the heights of the Dartmoor range flowed slowly through the valleys around Bovey Tracey, and into embayments on the spot on which the town of Newton now stands, and deposited the clay, derived from the felspar of the granite, where we now find it. Mr. Pengelly, who has recently investigated, with great care, the Lignite beds of Bovey Tracey, and the clay deposits above them, arrives at the conclusion that they are very recent. "Four species, three of *salix*, and one of *betula*," he says, when speaking of the organic remains, "have been found in this overlying mass, no one of which appears to differ from species now living. The presence of the *betula noma* is conclusive for a diluvial climate, that is, a colder climate than Devonshire has at the present day; for this dwarf birch is an Arctic plant, which has no British habitat south of Scotland, and which occurs in mid Europe only on ountains and sub-alpine peat mosses. The evidence of the willow leaves is to the same effect, indicating that at this period (when the clay was deposited) Bovey Heathfield was a cold peat-moor."

The mode of raising this clay is extremely simple; the workmen cut the clay out in cubical lumps, weighing about 30 lbs. each, fling the pieces by means of a pointed staff from stage to stage according to the depth; after which it is carried to the clay cellars, and thence shipped, when properly dried.

The analysis of this clay by Percy gives:—

Silica	52·06
Alumina	29·38
Potash	2·29
Lime	0·43
Magnesia	0·02
Oxide of iron	2·37
Water	10·27

From 13,000 to 15,000 tons are exported from Teignmouth annually. The fine clay being sold at 1*l*. 5*s*. the ton; stoneware, potter's clay at 12*s*. the ton; and drain-pipe and alum maker's clay at 8*s*. 6*d*. the ton.

CHINA-STONE.

Exhibitors.—**Same as China Clay.**

The china-stone, nearly all of which comes from the neighbourhood of St. Austell, as it is called, is a peculiar variety of granite, which has undergone decomposition to a certain extent. The granite is peculiar in its nature, since it rarely contains any mica, but numerous glossy scales of a greenish yellow talc.

The value of the china-stone raised in Cornwall, annually (which is the only county in England in which it is found), is about £19,000; the whole of which is sent into Staffordshire, where it is largely employed in glazing the finer varieties of ware. This stone is the same as the *Petuntze* of the Chinese.

MOULDING SAND.

Exhibitors.—Barringer and Carter (12), B. Barrow (13), Sir T. M. Wilson (409).

Collinson's Mansfield moulding sand consists of a remarkably fine sand, found only near Mansfield, on the borders of the ancient forest of Sherwood. It has a wide reputation among the modellers of the finest brass and iron castings, arising, no doubt, partly from its exquisite fineness of grain, but more particularly from its clay-like adhesiveness and plastic quality, combined with a total freedom from any coarse or gritty particles.

It is found under a deep deposit of coarse sand, ordinarily known as building sand, and within a short distance of the well-known white and red Mansfield stone quarries.

A sample of it was exhibited at the Great Exhibition of 1851, since which time its sale has increased.

The Isle of Wight sands, exhibited by Mr. Barrow, although different in character, should be examined in connection with this, as should those sent by Sir T. M. Wilson.

CRUCIBLES.

Exhibitors.—The Patent Plumbago Crucible Company (265), J. Juleff (183), J. Hall and Co. (134), J. Hynam (164), R. Smaile and Co. (330).

Of the various crucibles manufactured those formed of plumbago have acquired the highest reputation, being used almost exclusively in the European Mints and Government Works. The plumbago employed is very pure—some of the sample saveraging more than 98 per cent. of carbon ;—but in every case it is subjected to a careful scrutiny by experienced workmen, who are able to detect, and throw out any doubtful pieces. The plumbago then undergoes the process of grinding, in suitable mills, to different degrees of fineness, special regard being had to the metals for which the crucibles are intended. In like manner varying proportions of clay are mixed with the plumbago, the object being to avoid any excess which might yield a slag, and at the same time to effectively preserve the carbon from oxidation, when exposed for long periods at very high temperatures. The compound mass is thoroughly blended and brought to a proper plastic condition in revolving cylinders, when it is ready to be thrown in the manner practised in pottery manufacture.

The Patent Plumbago Crucible Company's white fluxing pots are made of a clay which is imported from the neighbourhood of Paris, mixed with an excess of cement. When the pots are moulded and have become nearly dry, a glaze is added by coating them with a thin paste formed of old glass pots ground into a very fine powder, and then mixed with water.

The English clay crucibles and muffles, are formed of a combination of the best Stourbridge clay, Cornish clay, burnt fire-clay, and free sand. The proportion used of each, and its fineness, being regulated so as to obtain with different degrees of porosity (whereby the liability to crack or fly is obviated) sufficient closeness in the grain to avoid any absorption of the melted metal. When thoroughly kneaded the clay is ready to be thrown.

The Cornish crucibles are usually formed of Teignmouth and Poole clay, combined with sand from St. Agnes Beacon —and a little china clay.

CHALK, WHITING, &c.

Exhibitors. — Meeson and Co. (223), The Queensgate Whiting Company (289).

The celebrated quarries at Grays belonging to the exhibitors are in many respects remarkable, but for nothing more so than the fossil remains of mammalia which are found in certain beds. The productions of a chalk quarry are not a little curious, this one producing—

Foundry loam, used for moulds for iron castings, luting for furnaces, &c. Clays, flints, chalk, lime, whiting, whiting sand, for asphalte, and plate-glass, and black flint, for pottery, building, gun-flints, &c.

The Queensgate Whiting Company have their works near Beverley in Yorkshire. The preparations of Paris white from these works—which will be found about the middle of the class on the eastern side—are of peculiar purity and fineness.

MILLSTONE GRIT, AND WROUGHT MILLSTONES.

Exhibitors.—**W. J. and T. Child (59), D. Dove (89), R. Forster (107), R. Kell and Co. (186), R. Micklethwait (228), I. Tasker (348), Hon. James Howard (159).**

Many examples of these will be found along the passage beneath the entrance to the Horticultural Society.

The difference of composition between coarse sandstones and those of finer grain is rather apparent than real. That all these sandstones are composed of the broken and triturated ingredients of older crystalline, generally granite, compounds, is evident upon inspection. Their most abundant ingredient, sand, is plainly in the state of minute pebbles, and the size of these grains is sometimes so very small, that their coherent mass assumes almost a crystalline aspect.

On the other hand, in millstone grit, they are of all sizes under an egg, though pieces of greater size than this are sometimes seen. These are evidently quartz pebbles of different kinds, corresponding to the quartz of veins and of granites. Rose quartz has also been observed. The next abundant ingredient is felspar, which is probably present in all these sandstones. In the millstone grit this mineral occurs in *rounded pebbles*, whose *internal structure is perfect crystalline*, like the large rhomboidal crystals in the porphyritic granite.

Excellent building stone is furnished by this rock in Yorkshire, Lancashire, and Derbyshire, and by its representative, the "Farewell Rock" of Dean Forest and South Wales.

These stones have the valuable property of standing great heat, and are therefore employed in certain parts of the iron furnaces.

The Buhr stones exhibited are of French origin, but they are cemented by an English process.

SANDSTONES, FLAGS, &c.

Exhibitors.—**J. J. Boxall (34), Earl of Caithness (51), T. Chaffer (56), G. Colley (64), G. Craig and Son (72), Duncan, Falconer, and Whitton (91), Ellis and Everard (99), A. Graham (124), Hampshire and Co. (137), G. W. M. Henderson (147), J. Holmes (156), J. Holroyd and Sons (157), Hon. J. Howard (159), T. Howard (161), J. Ibberson (165), W. Jennings (170), David Jones (175), G. Kaye (185), Duke of Northumberland (253), Nowell and Robson (254), R. Robson (304), W. T. Scarth (314), Straton and Cargill (343), Usworth Colliery Owners (382), G. Vint and Brothers (384), D. Walker (388), G. B. Wilson (407), T. Wood and Co. (414), Woodward Brothers (427).**

Sandstone is a term applied, without any strict meaning, to an extensive class of rocks. It is simply, in strictness, nothing else than sand, formerly loose and incoherent, subsequently compacted into solid stone. The grains, both of sand and sandstone, generally consist of quartz, sometimes clear and colourless, sometimes dull white, sometimes yellow, brown, red, or green. The red colours are usually the result of the covering of each little grain with peroxide of iron, which sometimes acts as a sort of cement to the stone, serving to bind the particles together. The green colours are commonly derived from silicate of iron; and the green and red are often intermingled, in consequence of the change of the iron from the condition of a silicate to that of an oxide or peroxide.

The size of the grains varies from that of a pea to the minutest particle visible to the naked eye, many sandstones and gritstones even requiring a lens in order to distinguish the particles of which they are composed.

Freestone.—Any rock which admits of being freely cut and dressed by the builder—not having any tendency to crack in any particular direction—is ordinarily termed a freestone. Mr. Chaffers exhibits some good examples of Portreaddyn, Worsthorne, and Portsmouth stone.

Green Sand.—J. Boxall (24). This sandstone, found in Kent and Sussex, derives its name from the occurrence of a number of little dark-green specks (silicate of iron), which sometimes give a green tinge to the stone.

DOLOMITES, OR MAGNESIAN LIMESTONES.

(*The Exhibitors grouped under Sandstones.*)

These stones are employed in the building of the Houses of Parliament.

The more important quarries from which the Magnesian Limestone is obtained, are those of Anston, of Brodsworth, Cadeby, and Park Nook, near Doncaster, of Huddlestone near Sherburne, and of Smawse near Tadcaster, in Yorkshire; while in Derbyshire the same stone of fine quality is obtained at Bolsover near Chesterfield, and at Mansfield-Woodhouse.

This stone is also found in Durham, and from the cliffs at Marsden it is largely quarried and used in the manufacture of Epsom salts. Its usual composition is:—

Silica	3·6
Carbonate of lime	51·1
Carbonate of magnesia	40·2
Iron and alumina	1·8
Water and loss	3·3
	100·0

A process was patented by Mr. H. L. Pattinson, and under that patent, magnesia is largely manufactured from this stone at the Washington chemical works, Newcastle-on-Tyne.

OOLITES.

Exhibitors.—J. F. Bentley (22), R. Brewer (36), J. Dabbs (79), T. C. Halliday (135), Daniel Jones (174), W. J. Powell (285), Rogers and Rawlings (305), O. N. Simpson (328), J. Wilson (408), S. Ruddock (309), E. Tuffley (376).

OOLITE. (*Oolith*, Germ. From *oov*, *an egg*, and *λίθος*, *a stone.*) Those varieties of limestone which are composed of an aggregation of small spherical concretions resembling in appearance the roe of a fish, and bound together by a calcareous cement. When first quarried they are generally soft, but harden by exposure to the air and the evaporation of the water.

The particles are generally formed of concentric layers of carbonate of lime arranged round a grain of sand, a fragment of shell, or some organic substance, forming the nucleus around which the calcareous matter has been deposited.

The name "roestone," from the fanciful resemblance of these oolitic concretions to the roe of a fish, has likewise been given to this kind of limestone when the grains are of small sizes; when of comparatively large dimensions, as in some beds of Inferior Oolite in the neighbourhood of Cheltenham, they are distinguished by the name of "peastone" or pisolite (from *πισον, a pea*, and *λίθος, a stone*).

The chemical composition of the oolites, as given by Professor Daniell, in the report for the selection of stone for the Houses of Parliament, is as follows:—

	Ancaster.	Bath.
Silica - - - -	..	..
Carbonate of lime - -	93·59	94·52
Carbonate of magnesia -	2·90	2·50
Iron, alumina - -	·80	1·20
Water - - -	·271	1·78

The "Bath stone" has been long celebrated: the principal quarries are Box, Coombe Down, Monckton, and Farley. In the restoration of Henry the Seventh's Chapel the Coombe Down stone was employed, costing about 40,000*l.* One peculiarity connected with these stones is that all free working limestones and oolites become in some degree harder on their surfaces by exposure to the weather. This is said to arise from a slight decomposition taking place, which will remove most of the softer particles, and leave the hardest and most durable to act as a protection to the remainder.

The Farley Down stone of Wiltshire is of this character, as is also the stone from the neighbourhood of Stamford.

PORTLAND STONE.—An oolitic limestone, immediately underlying the Purbeck strata; so called in consequence of its development in the island of Portland. (*See* Class X.)

LIMESTONES.—ORDINARY, HYDRAULIC, LIAS, AND OTHER VARIETIES.

Exhibitors.—E. and W. Aaron (1), Clay Cross Co. (60), Ord and Maddison (257), Greaves and Kirshaw (128), T. Quilliam (290), W. Sparks (337).

Limestones are of a very varied character; they are usually classified into compact and crystalline.

Compact Limestone is a hard, smooth fine-grained rock, generally blue or gray in colour. The deeper coloured and variegated kinds will be found grouped under Derbyshire and Devonshire Marbles.

Crystalline Limestone—of which no example occurs in this class—resembles loaf-sugar in its texture. (See the Statuary Marble in the Italian and other collections.) Oolites are limestones, but I have thought it convenient to group them separately.

The Lias group is essentially a clay deposit with argillaceous limestone in many of the lower beds—which are those employed for making hydraulic cement—and an argillaceous sandstone near the bottom.

Under this term are comprehended the strata which intervene between the Trias, or New Red Series, and the Inferior Oolite. In the aggregate they are of considerable thickness, and occupy a large area in this country, stretching in a north-easterly direction from the sea west of Lyme Regis in Dorsetshire, to Redcar, on the coast of Yorkshire.

By the term Lias,—which is a corruption, by a strange process, from "Layers,"—is ordinarily understood the calcareous and argillaceous division, which constitutes the lower section of the entire formation.

In an economical point of view this rock is of considerable value, from its furnishing a useful and durable stone, both for building and paving; for the latter purpose it is particularly suited, not only from the large dimensions of the flags it affords, but on account of its occurrence in thin layers, which in many cases, when required for rough purposes only, are used in the state in which they are taken from the quarry, without undergoing subsequent dressing. The lime furnished by the blue Lias is of excellent quality.

SLATES AND SLABS.

Exhibitors.—**J. W. Greaves (127), Bwlch-y-Groes Slate Co. (49), Cwmorthin Slate Co. (78), Duke of Devonshire (88), J. R. Eddy (96), S. Holland and Co. (155), R. B. Kinsman (188), Llangollen Slab and Slate Co. (204), J. Nicholls (249), Rhiwbryfdic Slate Co. (299), Rhorydd Slate Co. (300), Turner, Cassons, and Co. (378), Welsh Slate Co. (395), R. Williams and Co. (403).**

Slate is extensively distributed in Great Britain. Roofing-slate occurs on the western side of England, in Cornwall and Devon. The Delabole slate is exhibited. These quarries have been worked for a considerable period. Carew, in his survey of Cornwall, speaking of these slates, says :—"*In substance thinne, in colour faire, in waight light, in lasting long, and generally carrieth so good regards as (besides the supply for home provision) great store is yearly conveyed by shipping both to other parts of the realme, and also beyond the seas, into Britaine and Netherland.*" Borlase, in 1758, speaks of the extent of the workings of Delabole. The Delabole quarries produce, not only roofing-slates, but flagstones or brick-slates, which are highly esteemed for pavements in passages, courts, yards, &c., and for tombstones. The inscriptions upon old tombstones of the Delabole slate remain remarkably perfect, showing its durability when exposed to atmospheric influences. These slates are shipped at Tintagel and at Boscastle.

The slate quarries of North Wales are the most important in this country. The more important are situated as follows, and belong respectively to the geological formations named :—

Penrhyn	Bangor	*Cambrian.*
Llanberis	Dinorwic	
Ffestiniog	Port Madoc	*Lower Silurian.*
Llangollen	Llangollen	*Upper Silurian.*
Machynlleth	Aberdovey	*Lower Silurian.*
Royal Slate	Bangor	*Cambrian.*

The slates exhibited belonging to this series are chiefly from the quarries in the neighbourhood of Port Madoc. The Llangollen quarries are remarkable for the size of the slabs which they can obtain; a very fine example will be found in the open court adjoining this class.

The slate quarries in the neighbourhood of Ulverstone are also represented.

A good roofing-slate should split readily into thin even laminæ; it should not be absorbent of water either on its face or endwise, a property evinced by its not increasing perceptibly in weight after immersing in water; and it should be sound, compact, and not apt to disintegrate in the air.

The districts from which slates have been sent for exhibition have been estimated to produce the following quantities annually. The difficulty of obtaining exact returns from the quarries is so great, that this list can only be regarded as a near approximation.

	Tons.
North Wales – – –	352,700.
Delabole, Cornwall – –	17,050
Devonshire quarries – –	15,000
Lancashire and Cumberland –	3,500

Slates are so important, that many readers will be interested in knowing something of the cleaving and dressing of the slates. The splitter begins by dividing the block, cut lengthwise, to a proper size, which he rests on end, and steadies between his knees. He uses a mallet and a chisel, which he introduces into the stone in a direction parallel to the *folia*. By this means he reduces it into several manageable pieces, and he gives to each the requisite length by cutting cross grooves on the flat face, and then striking the slab with the chisel. It is afterwards split into thinner sections by finer chisels dexterously applied to the edges. The slab is then dressed to the proper shape, by being laid on a block of wood, and having its projecting parts at the ends and sides cut off with a species of hatchet or chopping-knife. It deserves to be noticed that blocks of slate may lose their property of divisibility into thin laminæ. This happens from long exposure to the air, after they have been quarried. The workmen say, then, that they have lost their waters. For this reason the number of splitters ought to be always proportionate to the number of block-hewers. Frost renders the blocks more fissile; but a supervening thaw renders them quite refractory. A new frost restores the faculty of splitting, though not to the same degree; and the workmen therefore avail themselves of it without delay. A succession of frosts and thaws renders the quarried blocks quite intractable.

The present consumption of slate in London is to the extent of about 60,000 tons per annum. One third of this quantity is in slabs, and the rest in roofing-slate, which are in nine sizes, called respectively "ladies," "countesses" (3 sizes), "duchesses" (2 sizes), "queens," "rags," and "imperials." From "ladies" (16 inches by 8) to "duchesses" (24 by 12), the slates are sold per thousand (of 1,200 slates), but above that size by the ton. The "ladies" weigh 25 cwt. the 1,200 slates, and the "duchesses" 3 tons. The regular-sized slabs vary from 1 to 6 feet in length, and 1 to 3 feet in breadth. A large quantity of slate slabs is now used for ornamental purposes.

Some very fine examples of split and of sawn slates will be found in the collections exhibited.

The slab from the Llangollen quarries is perhaps the largest ever obtained. This is exhibited in the Open Court with some others. There are, however, two remarkably fine, although smaller slabs, at the end of the Eastern Transept; these are supplied by the Llangollen Company, the Welsh Slate Company having one in immediate connection with the collection of slates.

Enamelled Slate, although exhibited in Class I., is considered by the juries in Class X., which see.

ELVANS.

Exhibitor.—Redruth Committee (296), F. Hill (153).

The origin of the term *Elvan*, which has been applied to a peculiar stone, somewhat of a granitic character, found abundantly in Cornwall, it is not easy to determine.

These rocks, which form, indeed, veins running through the other rocks, are sometimes granitic, and at others porphyritic, frequently changing from one form into the other. They have for the most part, however, a common mineral character, being chiefly composed of a felspathic or a quartzo-felspathic base, containing crystals of felspar and quartz, sometimes schorl, and occasionally, though rarely, mica.

The late Sir Henry De la Beche remarks of the Cornish elvans: "For durable stone, the harder elvans of this district, particularly when of good cream and other light colours, may be considered as the best building materials in it; their durability and appearance may be seen in many churches and old mansions, where the finer carvings of the ornamental parts are as sharp as the day they were put up. Occasionally the felspar crystals may have been decomposed and have been washed out, but the silicco-felsphatic base has remained firm, thus preserving the sharp character of the work."

I would direct especial attention to these stones, which have been collected with much care for the Redruth Committee and Mr. Hill by Mr. Garby of Redruth, a gentleman well known for his thorough acquaintance with the mineralogy of Cornwall. They are all exhibited with the collection sent to illustrate the economic geology of Western Cornwall.

IRON ORES.

The iron ores exhibited may be grouped into the *Red Hematite* exhibited from Whitehaven and Ulverstone. The *Brown Hematite* from the Forest of Dean, Cornwall, Devonshire, South Wales, and a few other less important localities. *Spathose Ore* from the Brendon Hills and Exmoor.

Argillaceous Carbonates and clay ironstones from the coal measures generally.

Black Band Ironstone from Scotland and South Wales.

Hydrated Oxides from Westbury in Wiltshire, Oxfordshire, Northamptonshire, Lincolnshire, Staffordshire.

Carbonates of Protoxide of Iron, as from the Cleveland district.

RED HEMATITE.

Exhibitors.—**R. Barker (9), Harrison, Ainslie and Co. (141), Schneider, Hannay and Co. (316), Parkside Mining Co. (263).**

Red Iron Ore—Sesquioxide of Iron.—The name Hematite is derived from the Greek word, signifying blood, on account of its colour. Theophrastus thus speaks of this iron ore: "And the hæmatites, or blood-stone, which is of a dense solid texture, dry, or, according to its name, seeming as if formed of concreted blood." This ore occurs in the carboniferous limestone; and millstone grit formations near the outcrop or surface edge of the slaty rocks on which that formation rests. It is evident upon a careful examination that this iron ore, as it occurs both at Whitehaven and at Ulverstone, has been derived from the yet older rocks, by the action, probably, of water charged with carbonic acid, and it has been slowly deposited in the state of oxide in cavernous openings in the rocks, or in ponds or fissures. The section of the Parkside mines will illustrate this. The former condition prevails in the Whitehaven district, the latter in the Ulverstone locality.

At the Parkside mines near Whitehaven the iron ore deposited has attained a thickness of 70 feet.

	From Cleator Moor.	From Ulverstone. Lindale Moor.
Peroxide of iron – –	95·16	94·27
Protoxide of manganese –	0·24	0·23
Lime – – – –	0·07	0·05
Phosphoric acid – –	trace	trace
Sulphuric acid – –	trace	0·09
Bisulphide of iron –	trace	0·0
Silica – – – –	5·66	4·90
Alumina – – – –	0·06	0·63

The quantity of iron ore sent from the Port of Whitehaven and used at the Cleator Moor and Workington Ironworks, in 1860, was 466,851 tons, valued at £256,768.

The quantity sent from Ulverstone and used in the locality, by the Barrow Hematite Ironworks (see model of these works), and at the Charcoal furnaces—the only ones in this country—of Harrison, Ainslie and Co., was 520,829 tons, of the value of £260,414.

BROWN HEMATITES; BROWN OXIDE OF IRON; HYDROUS OXIDE OF IRON.

Exhibitors.—Hon. J. Howard for Forest of Dean (159), J. Morcom, (235), Wm. Browne, (42), E. Rogers, (306), R. W. Wolston, Brixham (411).

This species affords always a yellow powder, without any shade of red, which passes sometimes into the bistre brown, or velvet-black. At the blowpipe it becomes brown, and very attractable by the magnet; but after calcination and cooling the ore yields a red powder, which stains the paper nearly as red as the hematite does, and which is much employed in polishing metals. All the yellow and brown oxides contain a large proportion of water in chemical combination. There are several varieties, which assume globular, reniform, stalactitic, and fruticose shapes. In many countries this is one of the most plentiful and valuable ores of iron; in the oolitic form it supplies by far the greatest number of the French iron-works, and it is this ore which exclusively supplies the Belgian iron-works.

It is found in this country in considerable quantities at Alston Moor and Durham, but is only used to a limited extent, on account of its association with lead and zinc; in the Forest of Dean, in Cornwall, and many other places.

The iron which the brown hematites produce does not at present stand high; it possesses fluidity, but has a great tendency to *cold shortness*, and is most suitable for foundry purposes.—*Blakewell.*

Dr. Noad gives the following analyses of brown hematite ores:—

Peroxide of iron -	68·45	67·77	66·98
Water - - - - -	12·80	12·40	13·20
Oxide of manganese	9·60	8·80	11·20
Lime - - - - -	..	..	..
Magnesia - - - -	1·10	1·20	1·08
Alumina - - - -	0·92	1·20	1·04
Sulphuric acid - -	0·11	0·10	0·096
Phosphoric acid -	1·02	1·12	1·054
Insoluble residue -	9·50	8·80	11·200
	101·20	99·79	100·85

The specimens of Cornish iron ores exhibited by Mr. Morcom are interesting.

I am desirous of calling the attention of those interested in the use of *magnetic iron ores*, from which the best iron for manufacturing steel is produced on the Continent.

This description of ore is scarce in this country. The magnetic ores exhibited are found in the parish of Ladock, in the county of Cornwall. Hitherto they have been shipped to South Wales for the ordinary purposes, but they are, no doubt, more valuable for the production of the better kinds of iron. The metallic mineral produce of Cornwall is usually found in lodes only, but this magnetic ore appears to be an exception, as it is found in a bed or seam. The thickness varies from six to ten feet. Some of the selected specimens will yield 97½ per cent. of oxide of iron.

The following counties produced—the chief portions being brown hematite ore—in 1860, as follows:—

	Tons.
Cornwall - - -	23,953
Devonshire - - -	9,836
Somersetshire - - -	24,101
Gloucestershire - -	90,466
Northumberland - -	12,500
Durham - - - -	40,000

Several fine examples of the Red and Brown Hematites will be found in the Open Court.

SPATHOSE ORE, OR SPARRY CARBONATE OF IRON.

Exhibitors.—Ebbw Vale Company (95), E. Rogers (306), F. Winn Knight, M.P. (190), The Weardale Iron Company (394).

In England the crystalline carbonate of iron occurs in the Devonian rocks of South Somersetshire and North Devon, in the carboniferous limestones of Northumberland, and in some of the mines of Cornwall.

Its primitive form is, like that of carbonate of lime, *an obtuse rhombohedron*. When heated before the blowpipe it turns brown without melting, and becomes attractable by the magnet after being slightly heated in the flame of a candle. Even by a short exposure to the air, after its extraction from the mine, it also assumes the same brown tint, but without acquiring the magnetic quality: after long exposure to the air, it becomes wholly converted into hydrated hematite.

The composition of this important mineral is shown in the following analyses by Mr. Henry and Dr. Noad.

	Henry, Somersetshire.	*Noad,* Somersetshire.
Protoxide of iron	37·33	52·66
Sesquioxide of iron	8·52	..
Protoxide of manganese	12·65	4·82
Magnesia	4·52	2·41
Lime	traces	1·25
Carbonic acid	35·80	38·68
	98·82	99·72

This ore, viewed as a metallurgic object, is one of the most interesting and valuable that is known; it affords *natural steel* with the greatest facility. It was owing in a great measure to the peculiar quality of the iron which it produces that the excellence long remarked in the cutlery of the Tyrol, Styria, and Carinthia was due. It was called by the older mineralogists, *steel ore*.

The spathose iron ores of Weardale are of much interest. They are found in a valley of the county of Durham, extending westward from near the city of that name to the springs which form the sources of the river Wear at the

Western boundary of the county, where it is separated from Cumberland by the mountain ridge which looks down on Nenthead and Alston Moor.

The geological formation is the carboniferous, or mountain limestone series, and the space through which the ore is found, in separated veins and masses, extends about fifteen miles from east to west, its average width being, from north to south, about six or seven miles.

The ores are all of the same general nature, consisting of the spathose, or sparry carbonate of iron, sometimes in a highly crystalline condition, and exhibiting distinctly the usual forms of its crystallization, and sometimes more compactly aggregated, and exhibiting those forms less visibly. The ores of Weardale have been all deposited in the condition of sparry carbonates; but in many places the ore has passed into the state of a *brown hematite*, viz., into hydrated peroxide of iron.

Mr. Ebenezer Rogers, of Abercarne, exhibits a case with three characteristic ores of iron, and some very illustrative sections. 1st. The spathose ore already described. 2nd. The calcareous hematite, which is just now attracting much attention in Germany, more especially used by Messrs. Krupp of Eissen, and by the aid of which they profess to make their large steel castings. 3rd. The iron stone found in the Devonian series, which exists in inexhaustible quantities. It makes the toughest pig iron yet known.

COAL-MEASURE IRON ORES, ARGILLACEOUS CARBONATES, AND BLACK BAND IRON ORES.

Exhibitors.—R. Barrow (14), Brown and Jeffcock (40), Clay Cross Company (60), Ebbw Vale and Pontypool Companies (95), Earl Granville (125), W. B. Mitchell (229), S. F. Okey and Co. (256), J. Ray (292), The Scotch Ironmasters (318), R. Smith (332), H. K. Spark (336), Weardale Iron Company (394), Yniscedwyn Company (429), Woodhouse and Jeffcock (424).

These ores are produced abundantly in our principal coal-fields; most plentifully in Staffordshire, the West Riding of Yorkshire, in Derbyshire, and in Durham and Northumberland. South Wales produces the argillaceous carbonates and black band. The iron ores of Scotland are obtained chiefly from the black-band ironstone, to which attention was first directed by Mr. Mushet in 1801, and who thus created that remarkable industry which distinguishes the country around Glasgow. The exhibition made by the Scotch ironmasters very fairly illustrates this. For especial information on these ores those who are interested are referred to the "*Iron Ores of Great Britain*," published in the memoirs of the geological survey of the United Kingdom. The composition of these important ores will be seen in the following analyses of three varieties.

	1	2	3
Protoxide of iron – –	45·22	36·14	33·72
Protoxide of manganese	1·35	1·38	1·01
Alumina – – – –	4·86	6·74	6·37
Lime – – – – –	1·63	2·70	3·99
Magnesia – – –	3·04	2·05	5·43
Carbonic acid – –	31·51	26·57	28·64
Phosphoric acid – –	0·38	0·34	0·41
Bisulphide of iron –	0·71	0·10	0·13
Silica – – – – –	9·64	17·37	16·02
Potash – – – – –	0·56	0·65	0·47

1, is from South Wales; 2, from Low Moor, Yorkshire; and 3, from Derbyshire.

THE HYDRATED OXIDES OF IRON.

Exhibitors.—T. Butlin and Co., (47), Westbury Iron Co. (130), Duke of Marlborough (217), T. Dyball (92), Hengistbury Iron Mining Co. (149), Bell, Brothers (18).

Many will remember the remarkable collection of iron ores exhibited in 1851, which were brought together by the zeal and industry of Mr. Samuel Blackwell, of Dudley. In that collection were three specimens of silicious ironstone; one from Saxelby, near Lincoln, and two from near Northampton, with a note—"The clay ironstones of the Lias are only just beginning to add to our iron-making resources." Since 1851 these ores have been extensively employed, and discoveries have been made over other very extensive districts, extending from the northern part of Lincolnshire to Peterboro' and Stamford, through Northamptonshire, Buckinghamshire, and Oxfordshire. The following was the produce of these counties in 1860:—

	Tons.
1. Northamptonshire, &c. -	95,664
2. Lincolnshire - -	16,892
3. Oxfordshire - - -	5,833

The analyses of these ores give respectively—

	1	2	3
Peroxide of iron - -	45·10	58·00	44·67
Protoxide of iron - -	1·25	..	0·86
Protoxide of manganese	·62	3·11	0·44
Lime - - - - -	..	0·91	9·29
Magnesia - - - -	·50	0·45	0·66
Alumina - - - - -	4·00	..	8·95
Phosphoric acid - -	..	1·32	0·55
Carbonic acid - -	2·28	..	6·11
Silica - - - - -	10·20	4·10	12·22
Water - - - - -	26·00	27·82	16·31

The Westbury iron ores are exhibited with an instructive section, by Mr. Greenwell. The section is that of the iron ore deposit of the Coral Rag, from its north outcrop near the Westbury iron furnaces, to the chalk hills. The brown ore is found where the bed lies within a few feet of the surface: under greater cover it is green, as shown in the specimens.

The iron which accompanies it is produced entirely from the native ore, used raw in the furnaces, with chalk for flux, and coke and coal, chiefly from Somersetshire, for fuel. From the coins and pottery discovered, as well as from old cinder occasionally found, it is evident that this ore was smelted by the Romans.

The Hengistbury iron ore occurs in the tertiary series, in a subdivision of the Bagshot group at Hengistbury Head, a promontory between the Isle of Wight and St. Alban's Head.

The Lincolnshire iron ores, exhibited by Mr. Rowland Winn (Wombwell Main Colliery) and Mr. Dyball, for Sir Cullen Eardley, are of recent discovery, and, from their great extent, of considerable importance. Their geological position is determined by the following section:—

	Yds.	Ft.	In.	
——	12	0	8	Oolitic limestone.
——	20	2	1	Grey shale containing nodules.
Lower Oolite –	2	1	10	Lower Oolite ironstone, the upper Northampton bed, not worth working.
Upper middle Lias	22	1	6	Blue shale with cement nodules
Middle Lias Marlstone.	1	1	2	Ironstone upper bed, Cleveland Pecten bed.
Lower Lias – –	29	2	9	Blue lias shale containing lower lias ammonites.
Lower Lias – –	8	0	3	Ironstone.
——				Blue lias shale.

Carbonates of Protoxide of Iron.

Exhibitors.—T. A. Barnes (11), Bell Brothers (18), Bolckow and Vaughan (31), J. and J. W. Pease (272).

Not more than fourteen years have elapsed since attention was accidentally directed to loose masses of a ferruginous substance, which were strewn over the beach on the north-eastern coast of Yorkshire; and experiments made at the furnaces of Messrs. Bolchow and Vaughan, near Bishop Auckland, proved it to be worth smelting as an ore of iron. Yet some little time elapsed before it was observed that these loose blocks had fallen from the higher ground in which a massive bed of the same material might be traced by its outcrop for miles and miles, along the escarpments of the Cleveland hills.

In 1860 that district produced 1,417,319 tons of iron ore, and there were in the Cleveland district proper 25 furnaces in blast, producing 248,665 tons of pig iron. At the same time the district supplied ore for 24 furnaces in Durham. Such has been the remarkable progress made in this locality within a few years, since the accidental discovery of a piece of ironstone on the sea shore! The analysis of this ore gives the following as its principal constituents.

Protoxide of iron – – –	39·92
Per oxide of iron – – –	3·60
Protoxide of manganese –	0·95
Alumina – – – –	7·86
Lime – – – –	7·44
Magnesia – – – –	3·82
Potash – – – –	0·27
Carbonic acid – – –	22·85

The specimens from the Whitby valley are of much interest. This ironstone appears in perfection at Grosmont with only a grass sod covering the seam; it materially deteriorates as it goes north towards Guisbro'.

The magnetic iron ore of Rosedale—of which some very fine specimens are to be found in the large Open Court, north of the class—is in every way a remarkable formation. This district will form an important one, as soon as its resources can be developed by the introduction of railway accommodation.

The examples given of iron ore exhibited must convince all that the story of the rapid exhaustion of our iron ores is altogether wrong. These islands possess the best iron ores, in unlimited quantity, for manufacturing the finest varieties of iron.

PIG IRON AND MANUFACTURED IRON.

South Wales.

Exhibitors.—Aberdare Iron Co. (3), Blaenavon Co, (29), Dowlais Iron Co. (90), Ebbw Vale Co. and Pontypool Co. (95), Governor and Co. (122), Swansea Local Committee (346), Yniscedwyn Iron Co. (429), Ystalyfera Iron Co. (431), Townshend, Wood, and Co. (369).

Lancashire.

Exhibitors.—Mersey Steel and Iron Co. (225).

Yorkshire (North Riding).

Exhibitors.—T. A. Barnes (11), Bolckow and Vaughan (31), Bell Brothers (18), Gilkes, Wilson, Pease and Co. (119), Jones and Dunning (176), Warners, Lucas, and Barrett (391)).

YORKSHIRE (West Riding).

Exhibitors.—Bowling Iron Co. (33), Farnley Iron Co. (101), Hird, Dawson, and Hardy (the Low Moor Co.) (154), Kirkstall Forge Co. (189), Monkbridge Iron Co. (232), Taylor Brothers and Co. (350.)

MIDLAND COUNTIES.

Exhibitors.—R. Barrow (14), T. Butlin and Co. (47), Butterley Co. (48), S. F. Okey and Co. (256).

STAFFORDSHIRE AND SHROPSHIRE.

Exhibitors.—Cochrane and Co. (62), Earl Granville (125), Moore and Manby (234), W. Robinson and Co. (303), R. Smith (332), Stainier and Son (339), Sutton and Ash (345), Shelton Bar Iron Co. (322), Lilleshall Co. (201).

DURHAM AND NORTHUMBERLAND.

Exhibitors.—Bell Brothers (18), H. K. Spark (336), Weardale Iron Co. (394).

SCOTLAND.

Exhibitors.—W. Baird and Co., W. S. Dixon, Merry and Cunningham, Houldsworth and Co., Wilson's Trustees, R. Addie, Wilson and Co., Dunlop and Co. (318).

LONDON. Exhibiting for various manufacturers.

Exhibitors.—W. Bird and Co. (27), Campbell Brothers (53), Moser and Sons (239), Dr. D. S. Price (286), A. Warner (390).

WESTERN COUNTIES.

Exhibitor.—G. C. Greenwell (130).

THE IRON MANUFACTURE of Great Britain has exhibited a rise more remarkable than that of any other human industry.

In 1750, the quantity of pig iron produced did not exceed 30,000 tons. In 1800, it had increased to 180,000 tons, and in 1825 to 581,367 tons. In 1826 the duties upon the importation of foreign iron were removed or rendered nominal; since which the production of iron has most rapidly increased, as the following table will show:—

	Furnaces in Blast.	Pig Iron made. Tons.
1835	..	1,000,000
1840	..	1,396,400
1847	433	1,999,608
1852	497	2,701,000
1857	628	3,659,447
1858	618	3,456,064
1859	607	3,712,904
1860	582	3,826,752
1861	Return not complete.	

During the last two or three years the iron trade has been in a very depressed state, consequently the number of furnaces in blast has been diminished; but, by the improvements made in the construction and in the working of iron furnaces, the production of iron from each has been largely increased.

The first process in the metallurgy of iron is the calcination of the ore, which is effected either in kilns or in the open air, in heaps; the object being to remove carbonic acid, water, sulphur, and all substances volatile at a red heat.

The next process is that of smelting the ore. The only flux employed is limestone, and the fuel is either coal or coke, or a mixture of these.

I am indebted to Dr. Noad for the following description of the varieties of cast iron. It appeared in my edition of "Ure's Dictionary of Arts, Manufacture, and Mines," to which I would refer those who are interested in our iron manufacture :—

"In commerce there are four principal varieties of cast iron, known respectively as Nos. 1, 2, 3 and 4, or *dark grey*, *bright grey*, *mottled*, and *white* ; these terms, although convenient, do not however indicate the intrinsic value of the iron thus denominated, as the variable qualities of ore, fuel, and limestone may exercise such an influence on the resulting crude iron, as to render a low denomination of one manufacturer of greater commercial value than a higher denomination of other makers. The general characters of the four varieties are these: No. 1. Colour, dark grey, in large rounded grains, obtained commonly near the commencement of the casting when the furnace is in good working order, and when an excess of carbon is present; in flowing it appears pasty, and throws out blue scintillations. It exhibits a surface where crystalline vegetations develop themselves rapidly in very fine branches; it congeals or fixes very slowly; its surface, when cold, is smooth, concave, and often charged with plumbago; it has but a moderate tenacity, is tender under the file, and susceptible of a dull polish. When melted over again, it passes into No. 2, and forms the best castings. No. 2. Colour, bright grey, of small grained structure, and interspersed only with small graphite laminæ; possesses great tenacity, is easily filed, turned, and bored; may even be hammered, to a certain extent; does not readily crack from change of temperature. No. 3 is a mixture of white and grey iron. On *strongly mottled* iron, little stars and spots of grey iron are found interspersed in bright or flowery iron; *weakly mottled* iron exhibits white specks on a grey ground. In *streaked iron*, grey iron is found above and below, and bright iron in the middle, with strong demarcations. No. 4. *White iron*, varies from tin white to greyish white; it is very brittle, cracking easily, even by change of temperature; it is extremely hard, sometimes even more so than hardened steel, so that it will resist the strongest file, and scratches glass easily. Fracture sometimes laminar, sometimes lamino-radiating, sometimes finely splintered, sometimes dense and conchoidal. As the fracture changes from laminal to conchoidal the colour likewise varies from white to greyish. Mean specific gravity 7·5. Expands less than grey iron when heated, cannot be welded because it becomes pasty at the very lowest welding heat. When heated to the melting point, it does not suddenly pass into the fused state, like grey pig iron, but is converted before fusing into a soft pasty mass. In this variety of pig iron the whole of the carbon is united to the iron; it is never used for casting, but always for conversion into malleable iron. The bright iron obtained from spathic iron ore contains the largest proportion of carbon (5·3 per cent. according to Kasten). A white iron is always the result of the derangement in the working of the furnace, though it by no means follows, that when the iron is white the furnace must necessarily be in a disordered state; the presence of manganese, for example, has a tendency to make white cast iron; but the quality may be excellent. The white iron resulting from derangement flows imperfectly, and darts out, in casting, abundance of white scintillations; it fixes very quickly, and, on cooling, exhibits on its surface irregular asperities, which make it extremely rough; it is exceedingly hard, though it is easily broken, the fracture being radiated and lamellar; the bar iron it affords is of inferior description. This kind of iron is always produced when the furnace is carrying a heavy burden of forge cinders, containing sulphur and phosphorus.

"Thus there are two distinct kinds of white cast iron. 1st. That obtained from ores containing a large proportion of manganese, crystallising in large plates; this variety is highly prized for making steel. 2nd. That resulting from a heavy mineral burden, or from a general derangement of the furnaces, or from the rapid chilling of fused grey iron crystallising in small plates; both are hard and brittle, the first more so than the last. Cast iron, which by slow cooling is grey, becomes white when it is cooled rapidly; on the other hand, when white iron is melted and allowed to cool very gradually, a portion of the carbon crystallises out as graphite, and grey iron is produced.

"In some iron works, *six* varieties of pig iron are recognized, which may be classified thus: 1st. First foundry iron, large crystals: 2nd. Second foundry iron, large and small crystals mixed: 3rd. Dark grey, all small crystals: 4th. Bright grey: 5th. Mottled: 6th. White, verging on mottled."

Many of the examples of manufactured iron now exhibited are of a very remarkable character. The Mersey Steel and Iron Company exhibit one double-throw crank-shaft of 1,350 horse power, intended for Her Britannic Majesty's steam ram Northumberland, or Minotaur, building at Blackwall. The weight of this shaft, as it came from the hammer, and as it is exhibited, weighs 24 tons, 10 cwt. 3 qrs. 19 lbs., and is the largest double crank-shaft ever made up to this date. One hammered plate of iron, exactly as it came from the hammer, 30 feet in length, 6 feet wide and 5½ inches thick, will be found in the Open Court. Two fine armour plates from John Brown and Co., of Sheffield, and some girders from the Dowlais Company, are also here.

From the works of Earl Dudley there are exhibited, by Mr. Smith, remarkable examples of bars of iron tied into knots, cold. The Blaenavon Company exhibit fine examples of rolled iron, in the form of weldless rails and tyres. The Butterley Company exhibit some very large plates of iron, and a rail 117 feet long, which has been placed in the large Open Court. The Governor and Company's works produce no less excellent productions. The Low Moor Company have some fine illustrations of the character of their iron; and the specimens of iron from the Bowling works, the Monkbridge works, and those of Taylor Brothers, are equally remarkable. From Earl Granville's and the Shelton works a plate is shown, and examples of hammered and rolled iron. The collection exhibited by Moore and Manby, of iron for engineers, fully maintains the high character of the British ironmasters.

Anthracite iron is shown by the Ystallyfera and Yniscedwyn Companies (429, 431).

STEEL.

Exhibitors.—W. Hawksworth and Co. (142).

The improvements made in the metallurgy of steel are well represented by these exhibitors, who thus describe their patented processes and manufactures :—

"First come various shaped tubes and rifle barrels made under Christophe, Hawksworth, and Harding's patent, without join or weld, out of a solid bar of cast steel, by a process of *cold* drawing and rolling, one or the other of these processes, or a combination of both, as follows. We take a piece of properly prepared steel, from six inches to a foot long, by from two to six inches diameter, through which a hole of a certain size is drilled, and afterwards by a series of drawings through a wordle and over a mandril (both of peculiar construction); the metal is elongated and highly polished at the same time, and reduced to the given shape and size, internal and external. Should the tube be desired for a gun or rifle barrel, it is afterwards passed through eliptical rolls, and the desired cone given; then placed in a matrix and the mandril drawn through to straiten the bore and bring it to the proper size. One machine worked by five men will turn out six hundred barrels per week; the process is simple, expeditious, and cheap: cast steel rifle barrels made under it can be sold at little over the cost price of the present ordinary iron ones; the principle is applicable to all ductile metals.

Iron in the various stages of purification from the pure metal, containing traces of carbon up through the malleable iron, cast steel, semi-steel, and cast-iron series.

Mills and dies for engravers to calico printers, and plates for bank-note and other engravers, from steel specially prepared and requiring no decarbonising or softening. Many other examples will be inspected with interest.

The steel plates, rail, and other articles, exhibited in Class XXXII. by Brown and Co., and others, have been prepared by the Bessemer process, which will be especially described when it becomes necessary to notice the examples exhibited by Mr. Bessemer himself.

COALS.

Exhibitors.—Cowpen Coal Co. (70), Coalowners of Durham and Northumberland (61), Bolckow and Vaughan (31), J. and J. W. Pease (272), Ramsay and Sons (291), Renwick and Nicholson (298), Sowerby and Phillips (335).

YORKSHIRE COAL FIELD.

Exhibitors.—Halifax Corporation (132).

MIDLAND COAL FIELDS.

Exhibitors.—Barber, Walker, and Co. (8), R. Barrow (14), Brown and Jeffcock (40), Clay Cross Co. (60), Firth, Barber and Co. (104), Lund Hill Coal Co. (213), Duke of Newcastle (248), S. F. Okey and Co. (256), Wombwell Main Coal Co. (412), Woodhouse and Jeffcock (415 to 425).

LANCASHIRE AND CHESHIRE COAL FIELDS.

Exhibitors.—Case and Morris (55), A. Hewlett, for Earl of Crawford and Balcarres (151), Leeswood Green Colliery Co. (196).

WELSH COAL FIELDS.

Exhibitors.—D. Davis (81), Lletty Shenkin Coal Co. (205), Morgan and Sons (238), Aberdare Coal Co. (2), Blaenclydach Coal Co. (30), G. B. Crawley (74), Governor and Co. (122), L. S. Mangus (215), Nixon, Taylor and Cory (251), Powell and Sons (284), Rhos Colliery Co. (301), J. Russell (310), Shephard and Evans (324), Yniscedwyn Iron Co. (429), A. Murray (243).

GLOUCESTERSHIRE AND SOMERSETSHIRE COAL FIELDS.

Exhibitors.—The Hon. J. Howard (159), J. Sanders (313), G. Greenwell, (129), Bristol and Forest of Dean Co. (38).

IRISH COAL FIELDS.

Exhibitor.—J. G. Adair (5).

SCOTCH COAL FIELDS.

Exhibitors.—Brown and Rennie (41), Finnie and Son (103), Pirnie Coal Co. (278).

The coals exhibited represent the general characters of our more important coal fields.

In these districts the present rate of production and the number of collieries is as follows:—

	No. of Collieries.	Tons of Coal raised in 1860.
Scotland – –	427	10,900,500
Durham and Northumberland	142	18,244,708
Yorkshire – –	387	9,284,000
Derbyshire, etc. –	205	6,215,000
Lancashire and Cheshire	324	12,100,500
Staffordshire –	568	7,648,300
Gloucestershire –	63	5,503,400
Somersetshire –	37	
Monmouthshire –	79	6,254,813
South Wales –	299	

The total number of collieries in the United Kingdom being 3,009, and the coal raised amounting to the enormous quantity of 84,042,698 tons in 1860; our total export of coal in that year being 6,788,060 tons.

Several varieties of coal are exhibited in blocks of various sizes, both in the Annex and in the Open Court; but these by no means represent the different kinds of coal which appear in commerce. As many as seventy denominations of coal are imported into London alone.

All these minute varieties are commonly included under four principal heads:—1, Caking coal; 2, Splint, or hard coal; 3, Cherry, or soft coal; and 4, Cannel, or parrot coal.

Caking coal is so named from its fusing or running together in the fire, so as to form clinkers, requiring frequent stirring to prevent the whole mass being welded together. It breaks commonly into small fragments, with a short uneven fracture. The Newcastle coal, and many others from different localities, are caking coals; they leave cinders and a dark dirty ash.

Splint, or hard coal, is well known in the Glasgow coal field; it is not easily broken, nor is it easily kindled, though when lighted it affords a clear lasting fire; it can be got in much larger blocks than the caking coals.

Cherry, or soft coals, is an abundant and beautiful variety, velvet black in colour, with a slight intermixture of grey. It has a splendent or shining resinous lustre, does not cake when heated, has a clear shaly fracture, is easily frangible, and readily catches fire. It leaves comparatively few cinders, and its ash is white and light; it requires little stirring, and gives out a cheerful flame and heat; the Staffordshire coals principally belong to this variety.

Cannel, or parrot coal, is called cannel from its burning with a clear flame like a candle; and parrot, in Scotland, from its crackling or shattering when burnt. Cannel coal varies much in appearance, from a dull earthy to a brilliant shiny and waxy lustre; it is always compact, and does not soil the fingers; its fracture is sometimes shaly, sometimes compact; the bright shining varieties often burn like wood, leaving scarcely any cinders, and only a little white ash. The duller and more earthy kinds leave a white ash, retaining nearly the same size and shape as the original lumps of coal. Cannel coal often takes a good polish, and can be worked into boxes and other articles. *Jet* is an extreme variety of cannel coal in one direction, as *batt* or carbonaceous shale is in another.

A specimen of cannel coal is exhibited from the mines of the Earl of Crawford and Balcarres, Haigh, near Wigan. The cannel of this mine is celebrated for the large quantity of gas evolved by distillation, and for the very highly illuminative power of the gas. It is largely used for gas-works at home and abroad; and the gas obtained yields a much purer and stronger light than that produced from ordinary coal.

The cannel sent from Ince Hall is of a similar character.

The brown coal, from the Pernie or Methill seam, is a valuable coal for gas and oil making; on analysis, it gives the following results:—

Specific gravity	1·126	
Gas per ton	13·500	feet.
Illuminating power	28	candles.
Coke and ash	36	per cent.
Hydro-carbons condensed by bromine	20	,,
Sulphuretted hydrogen	.½	,,
Carbonic acid	4¾	,,
Carbonic oxide	7¾	,,
Volatile matter in coal	65	,,
Specific gravity of gas	·700	

The Leeswood cannel coal, being a recent discovery, and having excited much attention, the following notice will be, to many, most acceptable:—

The adventurers bored to the cannel in September, 1857, at a depth of 132 yards from the surface. Early in January, 1860, in consequence of meeting with an upcast fault of 95 yards (about 200 yards west of the bore-hole), they came to the cannel at a depth of about 40 yards from the surface, and at this point they have been working ever since.

At the present moment they are raising from 2,300 to 3,000 tons per month, and they have been working at about this rate for the last twelve months. The seam varies in thickness from 3 ft. 4 in. to upwards of 6 ft., including the rich bituminous shale forming the lower part of the seam.

A tabulated statement of Dr. Fyfe's follows :—

COALS.	Cubic feet of Gas per ton.	Durability of Gas.	Illuminating power = candles.	Gallons of Sperm per foot.	Value of Coals in lbs. of Sperm.	Comparative Value of Coals.
Lasmahago	10,176	70·	8·7	1044	1517	2·86
Torbane –	15,482	84·4	10·3	1243	2736	5·13
Leeswood A	9,987	58·50	8·2	981	1401	2·64
Ditto B	14,280	82·30	10·9	1308	2668	5·025

Dr. Angus Smith's analysis :—

Volatile matter – – –	72·72
Carbon in the remaining cake	22·67
Ash – – – –	4·61

Anthracite is heavier than common coal, with a glossy, often irridescent lustre, and a more completely mineralized appearance. It rarely soils the fingers, has a distinctly sharp edged conchoidal fracture, or else breaks readily into small cubical lumps. It is not easily ignited, but when burning, gives out an intense heat, so as to sometimes melt the bars of the grate, or furnace, in which it is used. It does not flame, and gives off but little smoke, being in this respect similar to coke or charcoal.

A fine example of anthracite coal, from the four-feet veins at Hendreladis, weighing 38 cwt. is exhibited by the Yniscedwyn Company, as well as some other examples from Cwmtwrch, in the Open Court.

The anthracite district of South Wales produces about 800,000 tons per annum.

Bideford anthracite is exhibited by the Bideford Anthracite Company. This peculiar coal occurs in beds running through the slate rocks of the North of Devon. As they make a very considerable angle with the horizon, they are worked in the manner of lodes or mineral veins. They are very irregular in thickness, and are therefore expensive to work, except where a fair average richness can be obtained for some distance.

Mineral Black Paint.—A variety of the anthracite, probably formed from decomposed portions of it, is raised and employed as a pigment, especially in our dockyards.

The Radstock Coal-field is illustrated by Mr. Greenwell. The section exhibited is that of the coal measures, &c., from their outcrop, south-west of Radstock, to the latter place, being the lowest part of the basin upon this line.

The upper series produce house coal, which burns to a red ash: the average depths of the pits being 150 fathoms, and the thickness of the seams worked varying from 12 to 30 inches.

The lower series produce steam and coking coals, which burn to a white ash; the average depth of the pits being 100 fathoms, and the thickness of the seam worked varying from 16 inches to 6 feet.

The coal measures are covered in many places by the new red sandstone, lias, and inferior oolite.

The building-stones and lime exhibited with this collection are procured from the Mountain Limestone, and the Pennant rock of the Coal Measures; the Lias and the Inferior Oolite, and the best lime, which is also hydraulic, is obtained from the brown or upper bed of the Lias.

PREPARED FUELS.

Exhibitors.—Aberdare Steam Fuel Co. (4), Caso and Morris (55), Crown Preserved Coal Co. (77), A. S. Livingstone (202), Phillips and Darlington (274), Purified Fuel Co. (288).

The compressed and prepared fuels have one character in common. They are, usually, small coal cemented together by some bituminous matter.

PURIFIED BLOCK FUEL is prepared by the terrification of washed dust coal, and possesses in a remarkable degree the advantages of both coke and steam coal.

It burns with a clear flame without smoke, is nearly free from ash, and is well adapted both for general steam purposes and as a fuel for locomotives.

The Aberdare Patent Steam Fuel is made from the small of the South Wales steam coal, compressed by hydraulic machinery.

The bituminous matter used is coal pitch, broken up, and thoroughly mixed with the small coal over a furnace, in iron pans, in which are made to revolve, shafts with blades attached obliquely, so as, while stirring the material, to draw it several times from end to end; then put into iron moulds and pressed. The pressure applied is equal to about 2½ tons per inch.

The result of this pressure is, that a fuel is obtained, having a density exceeding that of many coals. Nixon's Duffrin has a specific gravity of 1·271; Powell's Duffrin of 1·267; the Aberdare steam fuel being 1·275; the Dowlais Merthyr exceeding it—being 1·315. The weight of a cubic foot of this fuel is 80 lbs.; the space occupied by one ton is 28 cubic feet.

The patent fuel prepared by Ince and Morris, is manufactured from the small of the best steam coal, which is ground moderately fine, and treated so as to absorb a certain proportion of liquid coal tar, and then pressed by machinery into blocks.

Its advantage over coals for steamers on long voyages, arises from its cubical form and density; it occupies less space by about 10 per cent. than ordinary coal.

These remarks are generally applicable to artificial fuels.

PEAT.

Exhibitors.—J. D. Brunton (43), R. Fitzgerald (105), The Moulded Peat Charcoal Co. (240), J. Parkinson, London (262).

For many years the utilisation of peat has been a subject of anxious consideration, both in this country and in Ireland. The mechanical preparations from this substance, being allied to coal, find their place in this class.

The Moulded Peat Charcoal Company, obtaining their raw material from Fens Moss, near Whitchurch, Shropshire, mould it by machinery, and dry it by artificial heat, according to the patent processes of Mr. C. Kingsford, C.E. It is then subjected to the carbonizing process, and produces a very hard charcoal, which is said to stand a greater blast than ordinary wood charcoal, and which may consequently be used to advantage in making pig iron.

This charcoal is used in preparing bars for wire, and plates for tinning, with advantage; it is also employed in the manufacture of phosphorus, for which the general use of lucifer matches creates a large demand. The sanitary properties of charcoal are tolerably well known, and the ground peat charcoal is admitted to have many excellent qualities in this direction.

Foundry Blacking, made from this charcoal, and used for covering iron, has been successfully introduced.

Peat condensed without pressure (Buckland's patent), is exhibited by Mr. Brunton, who exhibits the machine used in the manufacture, in Class VII.

Peat, as taken from the bog, is, by passing through a straining machine, deprived of its fibrous character, and is directly moulded into any desired form. In this state of pulp—the vegetable extract indeed being alone returned—it dries quickly, and, without any pressure, becomes as hard as oak, acquiring a specific gravity almost equal to that of coal. The cost is less than that of coal; it is strongly recommended by the exhibitor, for domestic fuel, for gas, and for generating steam; and he says, in the melting of iron it promises to be most beneficial, on account of its freedom from sulphur, and its resemblance to wood charcoal. The supply of peat is almost unlimited; and the article exhibited is now economically prepared, and the exhibitor assures us, it will stand the strong blast of an iron furnace.

MODEL OF THE UPLEATHAM IRONSTONE MINES.

Exhibitors.—**J. and J. W. Pease (272).**

The Cleaveland iron-ore district has been already described. This is an exemplification of the mode of working this ironstone and of conveying it to the base of the hill. Associated as the model is with a section, it renders itself perfectly intelligible.

SAFETY-CAGES, HOISTS, SKIP, &c.

Exhibitors.—**R. Aytoun (6), W. Bennetts (20), J. Calow (52), W. Corbett (67), G. B. Forster (106), J. K. Hampshire (136), W. H. Jordan (182), A. Knowles (191), J. M. Paull (266).**

The accidents in shafts, from breaking of chains, from overwinding, and from the fall of heavy bodies, amount to a serious number. A return, moved for by Mr. Dillwyn, member for Swansea, gives the following :—

1859 - - - -	165
1860 - - - -	157

It is to prevent accidents from these causes that safety-cages are employed.

Mr. Aytoun's disengaging catch is to insure the disengagement of the cage from the winding-rope in the act of overwinding. The arrangement may be described as a species of clasp-knife, which it resembles both in form and the duty it has to perform ; namely, that of cutting through an iron bolt, so as to allow of the cage being disengaged. This is exhibited in the Open Court. The arrangements in the others are similar, but ingeniously varied. In all the cages arrangements are made to prevent the cage or skip from falling, in the event of the chains or rope breaking, by some lever action or grip upon the guide rods. These vary considerably in the means of effecting this, but in the principles involved there is not much difference. The total deaths by accidents for three years have been—

	No. killed.	Coal raised. Tons.
1858	931	65,008,649
1859	904	71,979,765
1860	1108	83,208,581

SAFETY LAMPS.

Exhibitors.—**C. G. Crawley (74), Higgs and Son (152), H. Watson (392), C. H. Waring (389), J. Gray, M.D. (126), Jones and Charlton (173).**

All the safety-lamps which have been constructed since the introduction of them, by Sir Humphry Davy, are, in their main principle, the same. Their action depends upon the fact, that although an inflammable gaseous body will pass readily through wire gauze when not ignited—it will not pass through the gauze when in combustion—flame will not pass through the meshes of woven wire. Wire gauze is therefore employed, as the protecting shield, around the flame of an ordinary lamp. The lamps exhibited present some peculiarities.

The lamp exhibited by Mr. C. E. Crawley, is said to give more light than the "Davy," without the use of glass. This is effected by means of a draught through the centre of the flame, which arrangement is supposed to have the following advantages:—

That it prevents the wire gauze, except in extreme cases, from becoming red hot. It enables the lamp to consume from one to two cubit feet of gas per minute, should any be present in the mine. The increase of the light, removing the chief temptation to open the lamp. It is said that the flame cannot be driven through the gauze by a current of air.

Dr. Gray's lamp is another modification of Davy's lamp, and may be termed an overseer's lamp. It consists of a frontispiece with two eyes for the handles of the lamp; these handles support a ball of wire gauze; in the interior of the ball is the lamp, which is suspended on four pivots, so that in whatever way the lamp is moved, the light is always uppermost.

The miners' safety-lamp, exhibited by C. H. Waring, cannot be opened without first extinguishing the light. This object is attained by so arranging the fastening of the top of the lamp to the oil chamber that it cannot be opened until an extinguisher is brought down over the light, as only while held in this position can the lamp be opened.

Jones's self-extinguishing and detector safety-lamp provides only that security may be insured in any good lamp. It is free from springs of any description; the mere act of locking the lamp is its own security. Immediately upon the attempt to unlock it being made, the light is extinguished; thus, before the gauze top can be removed, all source of danger ceases, for the miner is in darkness.

Mr. Higgs' safety-lamp is intended for use in such parts of a colliery as may be in a very dangerous condition. The flame of the lamp is closed against the access of any air from without, and it is supplied with the air necessary for combustion from a cylinder in which it has been previously condensed. The cylinders are also exhibited.

SAFETY-FUSE AND BLASTING CARTRIDGES.

Exhibitors.—**Bickford, Smith, and Davey (23), Brunton and Co. (44), G. A. Copeland (66), Polglaze and Victor (279).**

There is scarcely a district in the country in which the safety-fuse has not taken the place of the old method of firing holes by means of the reed; consequently the number of accidents from explosions in mines and quarries are greatly reduced.

The safety-fuse was the invention of Mr. Bickford of Camborne; he patented it in September, 1831. Previously to this, fire was conveyed to the charge by a tube formed of quills; and before quills were used, rushes, from which the pith was removed, were very generally applied to this purpose. In some parts of the country, a tube of straw contained the gunpowder.

The introduction of safety-fuses has been the means of saving a large amount of human life. By the rude method of conveying fire to the charge in the hole bored in the rock, in the ordinary process of blasting, it frequently happened, that an explosion almost immediately ensued, and the miner was killed or injured in consequence. The safety-fuse is now extensively made by machinery: string being coiled so as to form a cylinder, receives the powder, which is especially manufactured for this purpose, and enormous lengths are constructed by this continuous operation. In practice, the charge of powder is placed in the hole, and the required length of fuse carried down to it. The hole is then filled in with sand or broken rock, which is firmly rammed down; the fuse passing out at the top of the hole. When all is complete, the miner lights the ends of the fuse, which, burning slowly, allows him to get away to a considerable distance before an explosion takes place.

In the blasting cartridges, exhibited by Mr. Copeland, of Constantine, Cornwall, it appears an elastic substance is placed in the upper part to prevent the possibility of explosion in the process of "tamping;" and the safety-fuse is united with the cartridge to afford facilities in use. The case is peculiarly constructed, so that the part of least resistance is at the lower end of the cartridge. This insures the explosive force being brought into action, at once, and continuously, during the short interval, at the bottom of the hole. These cartridges are adapted for all descriptions of work, and when employed in wet ground or under water, are coated with pitch, or sometimes with gutta-percha.

The metallic safety-fuse is prepared by filling a cylinder of lead, pewter, or other soft metal, with powder, closing the ends, and drawing it out. By this means, a continuous train of powder is left in the slender tube. The patentees recommend it for its safety and certainty of action; being metallic, they say, "it is self-sealing, and impervious to moisture, not liable to accidental ignition from a blow or uncertain action from damp, thus obviating the fearful and fatal accidents so frequently occurring from such unavoidable defects in other fuses."

ABEL'S FUSES FOR BLASTING BY MAGNETO-ELECTRICITY.

From time to time experiments have been made to blast rocks in quarries and mines by electricity. Although the voltaic battery has been used for firing mines in large engineering works—and that, in 1851, Mr. Ebenezer Rogers exhibited illustrations of the methods employed by him, economically, in sinking a shaft in his colliery by electrical agency—little has been done in this direction. Mr. Abel has constructed some fuses, which are exceedingly cheap and effective, while Professor Wheatstone has made arrangements by which magneto-electric machines can be employed instead of the more troublesome voltaic arrangements. I had an opportunity of experimenting with these in the Falmouth Docks in the autumn of 1861, and the results were most satisfactory. The magneto-electric machine is exhibited in Class XIII., and the manufacture of the fuses will be described with it.

TIN.

Exhibitors.—**S. Higgs and Son (152), Tavistock Committee (349), J. Tonkin (368), Redruth Committee (296), F. Hill (153,) R. R. Michell (226).**

There is but little doubt that Tin was procured from the rocks, and collected, by washing, from the streams of Cornwall and Devonshire, long before the invasion of Britain by the Romans.

The remains of ancient mine-workings, and the occasional discovery of rude furnaces, known as "Jews' Houses," with blocks of tin rudely cast, attest the high antiquity of this metallurgy. See the ancient tin in Mr. Hill's collection. The traditions and evidences which yet remain appear to confirm the statements made by Diodorus and others, that the Phœnicians traded with this country for tin. Probably the bronzes which decorated the palaces of the kings of Babylon and Nineveh were manufactured with British tin. While the ships of Tarshish brought copper from Arabia, there is but slight doubt that the merchants of Tyre obtained tin from those, then remote, "islands of the West."

Notwithstanding the high antiquity thus given to tin mining, and that a continued drain has gone on for certainly two or three thousand years, Cornwall and Devonshire are still producing very large quantities of tin. The products of the last few years have been—

	Tin Ore. Tons.	Metallic Tin. Tons.
1855	8,947	6,000
1856	9,350	6,177
1857	9,783	6,582
1858	9,960	6,491
1859	10,180	6,497
1860	10,400	6,656
1861	10,965	6,986

At one period, by far the largest quantity of tin was obtained by "streaming," that is, by washing the deposits in the valleys, in the same manner as the beds of ancient streams are washed for gold. Although some tin is still obtained from this source, by far the largest quantity is now got by mining.

Tin was until recently regarded as a comparatively superficial formation. Our grandfathers ridiculed the idea of the ores of this metal ever being found at a greater depth than copper ore. Discoveries have, however, been made of most valuable deposits of tin at considerable depths below the copper ores in the lode.

Dolcoath mine (a section of which is shown) was first worked as a tin mine, then as a copper mine, and now again at a great depth as a tin mine. This mine produced, in 1860, 805 tons of tin ore, the value of which was 64,974*l.*

Several other copper mines in the neighbourhood of Redruth and Camborne, in Cornwall, are evidently passing into tin mines as they increase in depth.

SEPARATION OF WOLFRAM FROM TIN ORE.

Exhibitor.—R. Oxland (258).

The tin ore of some of the Cornish mines is very considerably reduced in value by the admixture of wolfram (tungstate of iron). Ores, for example, which would sell for 60*l.* a ton, if pure, do not fetch more than 42*l.* per ton, if the tin is contaminated with this tungstate of iron. Mr. R. Oxland is the patentee of a process which has been very successfully employed in removing and utilizing the wolfram, and which is illustrated in a case in this division.

In consequence of the specific gravity of wolfram being greater than that of black tin, it could not be separated by any washing operation.

Such an ore is now mixed, in proportions indicated by the quantity of wolfram present, with soda ash, a crude carbonate of soda,—or salt-cake, sulphate of soda,—and the mixture, calcined in a reverberatory furnace provided with an iron bed to prevent the reactions that would otherwise take place between the constituents of the bricks, the soda, the tin, and the tungsten. By this calcination at a red heat, the tungstic acid leaves the iron and combines with the soda, producing tungstate of soda, which is soluble in water, and is thus capable of being easily removed. The residuary oxides of iron and manganese are then separated by washing, and the black tin obtained pure.

By evaporating and concentrating the solution of tungstate of soda, this salt is obtained in the crystalline form. It has been proposed to use this substance as a mordant for dyeing purposes, as a source of supply of metallic tungsten for the manufacture of alloys, for the manufacture of the tungstates of lime, barytes, and of lead to be used as pigments; and still more recently it has been found to be valuable, and preferable to any other substance, for rendering fabrics non-inflammable, so as to prevent the terrible accidents constantly occurring from the burning of ladies' dresses. For this purpose a patent has been obtained by Messrs. Versmann and Oppenheim. (See *Chemical Class.*)

For the manufacture of metallic alloys a patent has been obtained by Mr. R. Oxland, the exhibitor, as a communication from Messrs. Jacob and Koeller. Steel of superior quality, manufactured under this patent, is coming into use in Germany. It is prepared by simply melting, with cast steel, either metallic tungsten, or, preferably, what has been termed the native alloy of tungsten, in the proportion of two to five per cent. The native alloy is obtained by exposing to strong heat in a charcoal-lined crucible a mixture of clean powdered wolfram with fine carbonaceous matter. A black, steel-grey metallic spongy mass is obtained, resembling metallic tungsten. The composition of the alloy is shown in the following statement of the composition of wolfram:—

Tungstic Acid.		Oxide of Iron.		Oxide of Manganese.		
Tungsten	76·25	Iron	17·75	Manganese	6·00	= 100
Oxygen	19·06	Oxygen	5·07	Oxygen	1·71	= 25·84
						125·84

The steel works exceedingly well under the hammer; it is very hard and fine grained. Metallic tungsten, or native alloy, is also used for the manufacture of Britannia metal, by alloying with copper and tin.

COPPER ORES.

Exhibitors.—F. Bankart and Sons (7), C. L. Bradley (35), R. Gardner (113), S. Higgs and Son (152), J. Nicholls (249), Schull Bay Copper Mining Co. (317), J. Seccombe (320), Swansea Local Committee (346), Sweetland, Tuttle, and Co. (347), Tavistock Committee (349), Mona Mining Co. (231).

The ores of copper are found widely disseminated over the British isles. Those which are commercially valuable—and these are exhibited—are:

Copper Pyrites, Yellow Copper Ore, a double sulphide of Copper and Iron.—This is found in Cornwall, Devonshire, Wales, Lancashire, and Cumberland, and Yorkshire, and in Scotland and Ireland. Examples from those districts will be found.

Grey Copper Ore. Sulphide of Copper.—The difference between these ores will be best seen by their chemical composition.

	Yellow.	Grey.
Copper - -	30·15	77·16
Iron - - -	32·37	1·45
Sulphur - -	35·34	20·62

Malachite, or Green Carbonate of Copper.—The examples of which, from Schull Bay, are of considerable interest.

Red Oxide of Copper.—The crystallized copper ores exhibited by Mr. Seccombe are of great beauty and much mineralogical interest.

The Mona Mining Company, from the once famous mines in Pary's Mountain, in Anglesea, contribute several examples of copper ore (copper pyrites, or yellow ore), from different lodes; also a curious zinc ore known by the name of "blue stone," containing zinc (41 per cent.), lead (23 per cent.), copper, iron, sulphur, &c. It abounds in the Mona mine, and is of commercial value as an ore of zinc. In addition, iron pyrites, containing about 35 per cent. of sulphur; and sulphur obtained in calcining the ores on the mine, in large heaps, without fuel.

The waters flowing from Pary's Mountain, and passing through the vast heaps of refuse matter, which have accumulated around both the Mona and Pary's mines, contain a small quantity of sulphate of copper in solution. This is collected in large ponds, and old iron is thrown into it. By an electro-chemical action, the copper is precipitated at the expense of the iron. The iron is oxidized by exposure to the atmosphere, and immense deposits of oxide of iron are the result of this process.

This ochre is largely used in the manufacture of Venetian red paint; also, by a patent process, in the purification of gas.

The Devon Great Consols, from which mine some fine specimens of ores are exhibited, made returns to the Stannary Court, of copper ores sold in 1860, to the extent of 21,577 tons, valued at 106,170*l.*; and in 1861 of 20,588 tons of copper ore, valued at 103,713*l.* This mine is one of the most remarkable in this country. The shareholders were never called on for any money beyond the first 1*l.* per share. The price of these shares is now 420*l.*, and dividends to the extent of 782*l.*, have been paid on each of these 1*l.* shares.

The mass of copper ore exhibited by Mr. Bradley, from the Mountain Limestone of Yorkshire, is well worthy of attention.

The entire quantity of copper ore smelted, and copper produced during the ten years ending 1859, was as follows:

	Ore. Tons.	Copper. Tons.
British ores sold at public sales in Cornwall	1,795,207	121,681
Ditto at private sales – – – – –	214,860	54,890
Foreign, Colonial, Irish, and other ores sold at Swansea – – – – – –	384,292	55,537
	2,394,359	232,108

The estimated value of the copper produced from British mines, in 1860 was, £1,706,261; this was produced by the sale of 15,968 tons of copper.

We imported in 1861, 74,163 tons of ore; we exported in 1861, 14,865 tons in bricks and pigs, and 2,359 tons of sheet, &c.

COPPER SMELTING.

Exhibitors.—**F. Bankhart and Sons (7), Swansea Committee (346), The Mona Mining Co. (231), Sweetland, Tuttle, and Co. (347).**

An interesting notice of the history of copper smelting is given by Dr. Percy, in his 'Metallurgy.' In the same work will be found a detail of the various processes adopted for smelting the copper ores. To this the interested inquirer is referred. John Arthur Phillips' 'Manual of Metallurgy' may be consulted with much advantage.

There are sixteen copper smelting establishments near Swansea and Neath—the processes employed at these are well illustrated by the local committee of Swansea—these are the Mona smelting works, in Anglesea, and there are six smelting works at Liverpool and St. Helens, and one at Cheadle.

The smelting works around Swansea derive their copper ores from Cornwall, Devonshire, Ireland, and such Foreign and Colonial ores as are imported into South Wales. These are shown by the committee.

The Mona works smelt the ores, and the precipitate, from the Mona and Pary's mines in Anglesea, and from the copper mines of North Wales.

The smelting establishments at St. Helens and Liverpool obtain their ores from the Cumberland mines, from Alderley Edge, and such ores as arrive at the port of Liverpool. The works at Cheadle, where they produce a very fine copper, which is used in the manufacture of brass wire, select their ores carefully from different mines, somewhat widely scattered.

The specimens illustrative of copper smelting will be found to contain—

Calcined Ore.—Copper ore after the extraction of the sulphur, as described at No. 6.

Coarse Metal, obtained by the 2nd process of copper smelting, producing about 40 per cent. of copper.

Calcined Coarse Metal.—3rd process, for the extraction of sulphur from the coarse metal.

Metal "Brych."—4th process, producing about 65 per cent. of copper.

Close Regule.—5th process, producing about 70 per cent. of copper.

Spongy Regule.—6th process, producing about 80 per cent. of copper.

Blister Copper.—7th process, producing about 95 per cent. of copper

Select Ingot Copper.—Fine metal as prepared for market.

Tough Ingot Copper.—Ready for market.

Tough Cake Copper.—Hammered out by hand from the size of 19*a*, in illustration of the malleability of this copper.

Tough Bar Copper, as specially prepared for the manufacture of wire.

LEAD.

Exhibitors.—C. L. Bradley (35), J. Byers and Sons (50), J. Hunt (163), G. V. Irving (166), J. Nicholls (249), W. J. Scarth (314), H. Thomas (354–363), and Cardiganshire Mines; C. Williamson (404), T. Sopwith (334), Shield and Dinning (325), W. B. Mitchell (229), Rev. F. More (236), Cox Brothers and Co. (71.)

The lead ores of the United Kingdom may be regarded as fairly represented in all the varieties which are of commercial importance.

Lead, from the mines of Mr. Beaumont, M.P., in Northumberland, is shown by Mr. Sopwith in its several stages from the mine to the marketable produce known as "W. B. Lead." A cake of silver from the same mines, and plans and sections of the Blackett Level (seven miles long), driving by Mr. Beaumont for discovery of veins and unwatering the mines. The shafts are worked by Sir Wm. Armstrong's hydraulic engines.

The lead ores of Cardiganshire are shown from several mines, fairly illustrating its peculiarities. The history of lead-mining in Cardiganshire, which is of high antiquity and much interest, forms the subject of one of the *Memoirs of the Geological Survey*; in which volume Mr. W. W. Smyth has also described the physical and mineral conditions of that county.

The Shropshire mining district is illustrated by the Rev. T. More, who exhibits lead, copper ores, and other minerals. The Romans have left us evidences of their mining operations in Cardiganshire, in Scotland, and in Shropshire, as is shown, with regard to the latter county, in the tools and the fine pig of lead exhibited with Mr. More's collection. These were discovered about seventy years since, bearing undoubted marks of Roman labour, in the time of the Emperor Hadrian. A similar pig of lead was found a few years since, not far from the ancient mine, the Roman Gravels, which is a remarkable feature in this district, from its antiquity and produce; and from the unnamed, moated, and fortified places of residence in its vicinity, and the Roman roads and camps.

The commercial ores exhibited are the sulphides of lead or galena, consisting of lead 85·13 and sulphur 13·02. These ores contain, in very variable quantities, silver; those of Devonshire yielding 40 ounces of silver to the ton; those of the Isle of Man 20 ounces; of Ireland 10 ounces; of Westmoreland 12 ounces; of Cumberland 9 ounces; of North Wales 6 ounces; and in many cases not more than 2 ounces of silver to the ton can be detected.

There are exhibited the lead ores of Alston Moor, generally, and also specimens of lead ore from Brownley Hill lead mine, in the Greenwich Hospital Manor, containing 83 per cent. of lead, and 40 per cent. of silver.

Specimens of metallic lead, made at Langley Lead Works, Northumberland, from Brownley Hill Mine lead ores, containing 9 ounces, 8 dwts. 3 grs. of silver, per ton of lead, with specimens of lead crystals, desilverized lead, and litharge, and a specimen of cake silver, extracted from the same mine lead ores.

The total produce of silver from the lead ores of the United Kingdom, in 1860, was 549,720 ounces.

The production of lead ore being 89,081 tons, which gave of lead 63,525 tons.

In the cases from Mr. Sopwith, from Shield and Dinning, and from Cox Brothers and Co., of Derby, are cakes of silver separated from the lead. By a process, which dates back to the earliest ages of metallurgy, and which is described by the sacred poet Job and the prophet Jeremiah, lead and silver have been separated from each other, by oxidising the lead, and removing the oxide as it was formed. The late Mr. Hugh Lee Pattinson, however, discovered a process, which is most beautiful in its philosophy, and most valuable as a practical application of science.

This process of desilverizing lead is founded on the physical fact, that lead crystallizes at a temperature above that at which silver solidifies, and in this process of aggregation, the silver is separated from the commoner metal. It is effected by the use of hemispherical cast-iron pans, holding about three tons of metal, which are heated by a fire below them; the argentiferous lead is placed in these, and melted, after which the fire is withdrawn, and all made air-tight below. The workman now begins to agitate the mass, which he does with an iron rake, removing the solid parts from the edges as solidification takes place. With an iron strainer the solid crystals are removed as fast as they are formed; these are nearly pure lead, the liquid mass left behind being rich in silver. This process is repeated three or four times; the mass left after the last operation, which contains from 300 to 400 ounces of silver to the ton, is then submitted to the process of cupellation, by which the lead is oxidized, and the silver left in a state of purity behind. By the original method, lead ores containing less than 20 ounces of silver to the ton scarcely paid the expense of working. By this process, ores containing only three ounces to the ton are made to yield their silver.

The mines of the United Kingdom produced, in 1860, of—

Lead ore – – – –	89,082 tons.
Lead – – – –	63,525 „
Silver separated from the lead ores	540,849 ounces.
Silver from silver ores – –	8,871 „

At Treebisken Green and Mount Mine, in Perranzabuloe, Cornwall, five tons of argentiferous lead ores were raised, of the value of £915 2*s.* 1*d.* The phosphates of lead exhibited by Mr. John Hunt are of much interest.

WHITE LEAD.

(See CLASS II.)

Exhibitors.—Barker, Rawson and Co. (10).

White lead is the well-known pigment which, when ground in linseed oil, is used in house-painting. It is a carbonate of lead, generally containing hydrated oxide of lead, which is sometimes combined in the proportion of one atom of hydrated oxide to two of carbonate of lead. The most usual method (the Dutch) of manufacturing white lead is likewise the oldest. It consists in exposing lead to the joint action of acetic acid vapour, moist air and carbonic-acid gas. The lead is cast in the form of stars or gratings, and supported a little above the bottom of earthen pots (in shape like garden-pots), into each of which a small quantity of weak acetic acid is placed. The pots are then built up in alternate layers, with spent tanner's bark, until a stack is formed: each layer of pots being covered with boards. The fermentation, which soon takes place in the tan, serves the double purpose of furnishing carbonic acid, and raising the temperature of the stack, which reaches 140° Fah. After a lapse of six or eight weeks, the metallic or blue lead, as it is called, is converted into porcelain-like masses of white lead, which are levigated in water, washed, and dried. About 16,000 tons are annually made in England by this process. A very small quantity of acetic acid suffices for the conversion of a large amount of metallic into white lead: as, after it has combined with a portion of lead oxide to form neutral acetate of lead, this salt dissolves another atom of lead oxide, which is removed by the carbonic acid as carbonate of lead, and the neutral acetate set free, again to take up a fresh portion of newly-formed oxide of lead, produced by the action of the air on the metallic lead. Most of the new processes depend on similar reactions, with this difference, that oxide of lead (litharge) is employed instead of metallic lead: it is either made into a paste, with a small quantity of acetate of lead and water, or else dissolved either in a solution of neutral acetate, or neutral nitrate of lead, and submitted to the action of carbonic acid, produced by the combustion of coke or charcoal, which precipitates the dissolved litharge, leaving the acetate or nitrate at liberty to dissolve fresh portions. Another of the new plans consisted in precipitating a neutral salt of lead (the nitrate, for example,) with an alkaline carbonate.

ARSENIC.

Exhibitors.—T. Boundy (32), T. Garland (114), East Cornwall Arsenic Co. (93), Jennings, and Co. (169).

The manufacture of arsenic was confined almost exclusively to Cornwall, but it is now obtained in large quantities from the smelting works of South Wales. It is obtained in an impure state from the "burning-houses." These are kilns furnished with long flues, in which the metalliferous ores containing arsenic are "roasted," during which operation the sulphur escapes as sulphuric acid, and the arsenic sublimes, and is afterwards condensed. It is swept out of these, and subjected to a process of purification by more careful sublimation. The white arsenic exhibited is an oxide of the metal, the metal itself being of a dark-grey colour. The uses of arsenic are extensive: it is found advantageous, when combined with some metals, especially to harden them; it enters into the composition of type-metal, and of shot. It is used in glass manufacture, in small proportions, to produce transparency; in larger quantities to produce an opalescence in glass. Arsenic is also employed in the manufacture of enamels. The arsenical greens, which are mostly arsenides of copper, which are employed by paper-stainers and artificial-flower manufacturers, are of a highly poisonous character.

The total production of white arsenic in this country in 1860, did not exceed 1600 tons; the prices varied from 6*l.* to 10*l.* per ton, therefore the money value of the arsenic was about 12,000*l.*

MINERAL PRODUCTS OF THE ISLE OF WIGHT.

Exhibitor.—**Benjamin Barrow (13).**

Bricks are made from the clays of nearly all the tertiary strata. North of Arreton the brick-earth is a red mottled loamy clay, of the drift period, much resembling plastic clay, except that it is of a paler colour.

Lime.—The white marl underlies the lower chalk, or chalk without flints: immediately beneath it, forming the base of the chalk formation, occurs the grey marl. The latter when burned affords a greyish lime, which produces a useful hydraulic mortar.

Stone.—The quarries at Binsted have been worked for many centuries. Part of the cathedral at Winchester, Quar Abbey, in the Isle of Wight, and many of the old churches in Sussex, are built of stone from this locality. It is a tertiary limestone of fresh-water formation, as is denoted by the numerous casts of fresh-water snails which it contains.

The sandstone in the higher part of the Upper Greensand, furnishes a building-stone, soft, and easily worked when first taken from the quarry, but hard and extremely durable after exposure to the air.

Cement.—The cement stones of Alum Bay are septarian nodules obtained from the Eocene clays. They are argillaceous limestones, with small proportions of silica, carbonate of iron, &c., and are of considerable commercial value in consequence of their yielding a cement of the finest quality. This is prepared by calcining the stones in kilns, and grinding and sifting; after which it is packed in barrels, and sent to all parts of the world.

CLAYS.—The pipeclays of Alum Bay are especially interesting on account of the vegetable remains with which they are crowded. The produce (according to Messrs. Salter and De la Harpe) of a sub-tropical climate, like that of the Mediterranean.

SANDS.—The sands exposed in the cliffs, at the foot of Headon Hill, have long been noted for their whiteness and purity. They have been extensively worked there for many years, and exported to supply the glass-houses—chiefly of Bristol and London.

The pictorial representation of landscapes, ruins, &c., enclosed in glass bottles, with which most visitors to the island are familiar, are made from the variegated sands from Alum Bay. The design being first traced on the interior surface of the bottle with gum-water, the sands are introduced one after the other, and the design being in this way represented, by the film of sand which adheres to the glass, the interior of the bottle is filled with sand, and the bottom securely closed with a layer of plaster of Paris.

IRON ORES.—The clay ironstones, strewn on the shore between Yarmouth and Hampstead, are the remains of the tertiary beds of which they once formed a part, but which have been washed away by the sea.

COPPERAS.—The name of copperas is commonly given in many places to nodules and concretions of iron pyrites. They are found scattered along the shore at Brixton, and have been washed out of the cliffs. They are commercially valuable for making copperas and sulphur. The manufacture of culinary salt was formerly carried on to a considerable extent at Newtown, and other places in the Isle of Wight, in what are called salterns.

These are large shallow pits into which the sea-water is admitted, and exposed to evaporation by the action of the sun and wind. The strong brine obtained by this process is finally precipitated by boiling.

Very little salt is made in the island now, and that only for inferior purposes.

ORNAMENTAL STONES.—The ornamental stones picked up along the shore at Brooke, Bixtor, Sandown, and Ventnor, and commonly known by the name of Isle of Wight pebbles, are for the most part flint-pebbles, derived from the chalk. Their beauty is chiefly owing to the various tints produced by the different state of oxidation of the iron, &c., which forms their colouring-matter, and to the sponges and other organisms whose structure is still apparent, although replaced by chalcedony and jasper.

The so-called Isle of Wight diamonds, picked up along the shores of the under-cliff, are small pebbles of quartz, which have been derived from the Wealden strata.

COPROLITES—FOSSIL BONES—AND BIPHOSPHATE OF LIME MANUFACTURED THEREFROM.

Exhibitors.—Packard and Co. (259), J. Matthews (221).

Under the term coprolites are now included the organic remains of various kinds which are found with the true coprolite. These are now, or have been recently, worked at Cambridge, Barnwell, Fen Ditton, Burwell, Swaffham, Honnington, and Comberton, in Cambridgeshire, and Ashwell, in Hertfordshire; the annual production being above 20,000 tons. They are also obtained from Foxhall, Ipswich, Nacton, Boyton, Butley, Bucklesham, Shotley, Bawdsey, and Shottisham, in Suffolk, which county produces about 10,000 tons a year.

These fossil remains are found extremely valuable for agricultural purposes, forming the basis of the manure sold under the name of superphosphate. They consist of two distinct varieties, one from the Suffolk Crag, resting on the London clay, the others are found mixed with the Upper Green Sand, and principally in Cambridgeshire.

The specimens from the Crag are chiefly rolled pebbles, presenting a polished surface, with a small proportion of more or less perfect specimens of the bones of various animals, as also some fish and crustacea; they contain, when washed and reduced to powder, about 56 per cent. of phosphates, readily converted into biphosphate of lime, by the addition of sulphuric acid.

The Green Sand variety are rougher externally, of various form and size, having a few fish teeth, and some vertebræ among them; these yielding, when washed and reduced to powder, 60 per cent. of phosphate, which are found more soluble in acid, and in consequence have the preference over the Crag fossils.

The superphosphate manufactured from these, frequently contains as much as 28 per cent. of phosphates rendered soluble; and from the abundance of the supply, amounting to some 50,000 tons and upwards per annum, present the cheapest source from whence phosphates can be obtained.

To the geological student, as well as the scientific agriculturist, these remains present features of peculiar interest. The name, pseudo-coprolite, has recently been given them, from their resemblance to the Lyme Regis coprolites: that some portions are bone is conclusive, and, probably, many more were so originally, having, when first deposited, become united with earthy matters, and afterwards rolled into their present form.

The following analyses are by Mr. H. K. Bamber:—

CAMBRIDGESHIRE COPROLITES.

Water and Organic Matter	4·50
Chloride of Sodium	Trace
Sulphate of Lime	2·23
Carbonate of Lime	18·25
Phosphate of Lime	60·87
Magnesia	Trace
Alumina	2·50
Oxide of Iron	2·80
Fluoride of Calcium	1·80
Silica	6·50
	99·45

SUFFOLK COPROLITES.

Water and Organic Matter	5·400
Chloride of Sodium	Trace
Sulphate of Lime	1·632
Phosphate of Lime	53·400
Carbonate of Lime	17·500
Magnesia	Trace
Alumina	4·400
Oxide of Iron	6·000
Fluoride of Calcium	1·450
Silica	9·750
	99·532

MINERAL PAINTS.

Exhibitors.—Bideford Anthracite Mining Co. (25), R. W. Wolston (411).

Bideford and Mineral Black Paint.—This superior paint has been exclusively used in Her Majesty's dockyards and arsenals, for the last forty years; its properties are thus spoken of in a certificate bearing date, August 12th, 1847. "Its superiority is observable in the preservation of wood, iron, and canvas; it covers the work well, dries quick and hard, is more durable, and does not blister like other blacks, and has a body inferior only to white lead."

The iron paints from Torbay have been much used in dockyards, arsenals, &c., for coating materials under water.

Their peculiar characteristics are, great covering properties, 62 lbs. effectually coating as large a surface as 112 lbs. of lead paint; economy and durability, protection of iron from corrosion, arresting oxidation at any stage, and resistance to sulphureous and other gases.

Specimens showing these qualities are exhibited with the paints.

OCHRE.

Exhibitors.—Messrs. W. H. Jenkin and Sons (168), F. More (236).

These ochres and umbers are in a great measure free from potash and soda, as well as from grit.

Papers coloured with ochres or umbers not purified from potash and soda, quickly absorb moisture, causing serious injury to silks, cutlery, books, &c., which may be wrapped in or lined with them; and papers stained with unpurified colours quickly become mouldy, and the colours dull. If manufactured into oil pigments, a much greater quantity of oil is required.

ORE-DRESSING MACHINE.

Exhibitor.—John Hunt (163).

This is the only machine of the kind exhibited, which, seeing the value of these machines, is to be regretted. It is a model of an ore-separator, and portable gold-washing machine.

The ore-separator can be worked by a boy, and will treat a cubic foot of poor ore in fifty seconds; it is used for the separation of all kinds of ore, and is worked in two ways, viz., by allowing it to feed itself by means of a hopper, and discharging the waste at the other end, by the action of the water only, the ore passing into a hutch below; or the water required for its use may be returned to the valve, and used over and over again; by this arrangement the refuse is removed with a scraper.

The portable gold-washing machine is particularly applicable for the treatment of auriferous sand, &c., a large quantity of which may be treated in a very short time, by its use.

BORING MACHINES AND EXPANDING WEDGE.

Exhibitor.—James Gowan (123), P. S. Reid (297).

One of these machines in the Open Court is for boring holes in stone, on the drill principle: its chief value is, that holes can be drilled of a larger size and greater depth than by the hand process. The best plan for its use is to bore a row, varying from six to ten holes, and fire the hole by a galvanic battery; by this means and by preserving a careful balancing of powder, the stone may be cut with as little damage to the rock as is done by wedging. There is another boring machine intended to do the same work as the one just mentioned, only it is smaller, and comes nearer the hand stroke of two men.

The expanding wedge is very simple in its application, and its value consists in the great saving of manual labour.

Mr. Reid's boring tools have been constructed from the results of a somewhat extensive experience in boring.

SALT.

Exhibitors.—John Corbett (68), Salt Chamber of Commerce (311).

Culinary salt is composed, chemically speaking, of single equivalents of sodium and chlorine, or of 39·4 parts of sodium, and 60·6 of chlorine in 100 parts by weight.

The geological position of rock salt is very variable; it is found in all sedimentary formations, from the transition to the tertiary, and is generally interstratified with gypsum, and associated with beds of clay. When the latter is present in large quantity, the term "saliferous clay" is applied to the deposit. The great British deposits of this substance, in Cheshire and Worcestershire, are found in the new red sandstone. At Northwick, in the Vale of the Weaver, the rock salt consists of two beds, which are not less than 100 feet thick, and are supposed to constitute large insulated masses, about a mile and a half long, and nearly 1300 yards broad. There are other deposits of rock-salt in the same valley, but of inferior importance. The uppermost bed occurs at 75 feet beneath the surface, and is covered with many layers of indurated red, blue, and brown clay, interstratified more or less with gypsum, and interspersed with argillaceous marl. The second bed of rock salt lies 13½ feet below the first, being separated from it by layers of indurated clay, with veins of rock salt running between them. The lowest bed of salt was excavated to a depth of 110 feet, several years ago.

Stoke Prior Salt Works, Worcestershire, are on a most extensive scale, their capability being about three thousand tons per week of manufactured salt. These works were erected at a cost of about half a million sterling. The brine pits are the deepest in England, and cost about 50,000*l*. in sinking. The bed of transparent rock salt is 39 feet in thickness; the brine springs of more than ordinary purity.

MODEL OF IRON FURNACES AT THE ULVERSTONE IRONWORKS, LANCASHIRE.

These works embrace most of the more important improvements in iron making, which may be stated as follows:—

Designed originally for an output of 800 tons per week out of four furnaces, the make of iron for 1860 reached 46,000 tons, out of an average of less than three in constant work.

In 1861, two more furnaces were built, and the make this year (increased by an additional furnace for the last three months) was 69,000 tons; but as the engine power was not equal to blow more than four furnaces, the make per furnace was not increased in proportion by the addition. At the present time a seventh furnace is building, large additional steam power is being provided, and when the improvements now in course of being carried out are fairly in operation, the make of these works, with six furnaces in regular work, will be about 2,500 tons of pig iron per week, an average yield for each furnace of over 400 tons per week—an amount, so far, unprecedented in the iron trade.

The peculiar features of the works are the method of collecting the waste gases at the top of the furnaces, a patent of Mr. Smith's; the arrangements for preventing the influx into the gas tubes of any atmospheric air; the arrangement of the heaters, by which a constant temperature of 800° Fahrenheit is maintained in the air blown into the furnace; the introduction of air in minute jets under the boilers and in the ovens, to produce complete and instantaneous combustion of the gases; and the final withdrawal of the spirit gases from the flues by means of large fans. The mechanical details of the filling apparatus, the arrangement of the inclines, engines, waggons, and balance weights, are all new and complete, and the facility with which nearly 8,000 tons of material per week can be filled at the foot of the incline, taken to the top of the furnaces, and finally deposited in the exact place and furnace required, without inconvenience, hurry, or confusion, is the best practical proof of the simplicity and efficiency of the machinery and means employed.

The ovens for raising the temperature of the air before being blown into the furnaces, one of which is shown dissected in the model, have proved to be admirably adapted for their work. About 7,000 cubic feet of air are required per minute, for each furnace, and the raising of the temperature of this quantity to a point that will enable it to melt lead, before entering the furnaces, has always been a practical difficulty and expense in iron works, the solution of which, even in the best works, has scarcely been satisfactorily brought about. When using the waste gases from the furnace for this purpose, the slightest leakage of the pipes at once produced an intense local heat that soon destroyed the iron work, whilst the expansion of highly-heated pipes, and the difficulty of making air-tight joints under the extreme temperature required, were attended with great difficulty and expense. The ovens at Barrow are capable of maintaining an uniform temperature in the air at the tuyeres of 800°, or 200° above what is required to melt lead; and the arrangement of the pipes is such, that no amount of expansion is liable either to break the joints or disturb the air-tight condition of the heating pipes.

The boilers for raising the steam for the engines are entirely worked by the gas from the furnace, and when all the connections are made, and the new fan engines at work from all the flues, it is estimated that about 1 cwt. of slack per ton of iron made will suffice for every purpose, keeping up one boiler in each series as a reserve in case of accident, and having the means at once of firing in the ordinary way, should such be desirable.

The fans are entirely a new feature in iron works, and will contribute to the regularity and uniformity in working the gases. The fans are worked by two 40-horse engines, with cylinders 24 inches diameter and 4 feet stroke, which communicate by means of driving wheels of 16 and 18 feet diameter, with four fans on each side of the engine-house 10 feet 6 inches and 13 inches in diameter, the fans drawing the products of combustion by a central underground flue, and discharging it at the circumference, by means of another flue, into a large chimney.

The blowing engines, three in number, of 400-horse power, nominal, but working to more than double this, are independent beam engines, blowing into one common receiver. Two of these engines have steam cylinders 47 inches in diameter, and the third 50 inches, the stroke of all being 9 feet. They use steam of 25 lbs. on the square inch, and work expansively. The blowing cylinders, two of 98 inches, and the other 105 in diameter, are capable of discharging 48,000 cubic feet per minute at a pressure of 3 lbs. on the square inch.

The make of iron by the most recently constructed furnace has been given me as follows:—

Quantity of iron made in No. 6 furnace for eight days ending April 10th, 1862—

	Tons.	cwts.	lbs.
April 3	77	13	2
„ 4	76	1	2
„ 5	88	18	2
„ 6	83	0	3
„ 7	81	8	2
„ 8	91	1	2
„ 9	94	5	2
„ 10	87	17	1
	8)680	7	0
Average per day	85	1	0

All good grey iron. The furnace is still working at the same enormous rate.

MODEL OF DOCKS AND HARBOUR ENTRANCE AT SUNDERLAND.

Exhibitors.—The Local Committee.

MODEL OF SEAHAM HARBOUR.

Exhibitor.—The Marchioness of Londonderry.

These well-executed models sufficiently explain themselves. They show the manner in which the harbours have been made, at great cost and under no common engineering difficulties, by actually invading the realms of ocean. Accompanying and illustrating these, are two models illustrative of the methods in use—at the ports of the northern coal fields—for loading coal.

MODELS OF PLAN FOR VENTILATING COLLIERIES, AND OF CONVEYANCE OF COAL UNDERGROUND.

Exhibitors.—**Wood and Daglish (413).**

These models show the most approved methods, employed in the most carefully worked collieries of Durham, for securing a sufficient current of air to remove any carburetted hydrogen (*fire-damp*) as it may be given out from the workings, or any deleterious gases from the colliery. The model shows the mode of working by pillar and stall in small isolated pannels; each pannel is ventilated by a distinct current—the naked lights only to be used in working the whole coal, and to be removed out of each pannel before commencing to work the pillars. The pillars are 60 yards by 40 yards, and can either be removed in lifts or by the long wall mode of working. The underground railway is an arrangement replete with all the advantages derivable from a similar arrangement on the surface. A 40-horse power engine, with 18-inch cylinder, 3 feet stroke, and 6 feet rope drums, are employed. The rope drums are arranged to work on different shafts, and are quite independent of each other, with breaks and unshipping apparatus. It will be understood that these underground railways save the employment of horses, and in large collieries they are found to be economical.

VENTILATING FURNACE.

Exhibitor.—**J. Daglish (80).**

It will be understood that one mode of ventilating our large collieries is to convert one of the shafts, or one side of a divided shaft, into a channel, through which the air ascends from the workings below. If the air is heated it becomes specifically lighter and ascends—its place being supplied from the surrounding mass. The use of this furnace is to so heat the air, and thus produce great ascensional power, without allowing the air of the mine to come into contact with the fire itself.

MODEL OF WILLIAMSON'S SYSTEM OF COLLIERY VENTILATION.

Mr. R. Williamson's method of ventilating collieries (406), as applied to three of the best-known systems of working at present in use, are shown.

We have the Longwall system, as used in Yorkshire, Durham, &c.; the Longwall system, as used in Staffordshire, Lancashire, &c.; the Pillar and Stall system, adopted in the northern collieries; and also to a system of working proposed to be adopted in "fiery mines," which he has designated the "Isolated Stall system."

The following advantages are claimed by Mr. Williamson in his method of ventilation:—The gas, or "fire-damp," which is not explosive until mixed with atmospheric air, is withdrawn from the mine before it can be thus mixed. Where a "blower," or sudden escape of gas occurs, the miners have only to retire from that vicinity until the gas is withdrawn; no interruption occurring to the other workings. The "goaves," or wastes of the mine, usually dangerous reservoirs of fire-damp, become safety valves for the gas of the mine, being thoroughly drained by this system. No dangerously strong currents are necessary. The frightfully destructive effects of the "after-damp," by which more lives are lost than by the explosions, will be entirely prevented. Greater facility and economy in working; and in the "Isolated Stall system," proposed by Mr. Williamson to be adopted in very fiery mines, the explosion and its effects will be exclusively confined to the stall in which it occurs.

MODELS OF SHIPLEY COLLIERY.

Exhibitors.—**Woodhouse and Jeffcock (425).**

These models show the surface of the country—the section of the coal measures—with some good examples of "*faults*," "*slides*," or, as they are sometimes emphatically called by the miners, "*troubles*." These may be explained to the uninitiated as dislocations occurring across extensive tracts of country, one portion having subsided, or been upheaved, as the case may be. This will be evident if the observer will mark the line of any particular stratum up to and beyond the fault. The order of the occurrence of coal and the modes of working can be studied in the two models of Shipley exhibited. The system of working represented is that known as the "Longwall system." The vein is 3 feet thick, and the "stalls" are carried 100 yards wide, while the gate roads through the "goaf" are 15 feet wide.

The second model is of the pit bank and surface arrangements, showing the position of winding engine, with pits, of which there are two, each 7 feet in diameter, from which 100 tons of coal are raised per day.

MODEL OF COAL TIP.

Exhibitors.—**The Taff Vale Railway Company.**

This is a very perfect one, showing the improved tipping-cradle, coal-shoot, with two screens, stop-doors, and self-acting lowering-box, called the "anti-breakage" apparatus, which is used for the purpose of filling the hold of the vessels to the level of the hatches, previously to tipping the coal in the regular way down the shoots: this apparatus is managed by means of a break, the counterbalance drawing up the empty box; and the full box being heavier than the counterbalance, of course draws that up in turn. There are also connected with this coal-tip some booms, worked by means of cogs, which are used for the purpose of shifting the vessels further out of berth. Some idea of the capabilities of this coal-tip may be formed from the fact that four men are able to load into a vessel 100 tons of coal per hour.

MAPS OF THE GEOLOGICAL SURVEY OF THE UNITED KINGDOM, AND SECTIONS.

On the wall of the entrance to the Horticultural Gardens is suspended a large Map, comprising the greater portion of those parts of England and Wales which have been geologically surveyed. By its side are hung a number of horizontal and vertical sections, illustrating several lines of country across the Welsh and English counties. An index of colours will indicate to the observer the formations signified by the tints which have been employed both on maps and sections.

The Geological Survey maps, which have been published, comprehend the whole of the principality of Wales, and nearly all the English counties south of the Medway, and westward of a line drawn from the eastern side of Derbyshire to the Isle of Wight.

This includes an extensive series of rock formations. We have, in the west, those rocks which are of igneous origin, and which preserve no indication of any organization, such as granites, syenites, porphyries, and greenstones or traps. The Palæozoic rocks, including in their lower and upper divisions the Cambrian and Silurian formations, the Old Red Sandstone or Devonian, the Carboniferous rocks, and the Permian group, which have each their special relics of primeval life, form another great division. This section of the Map "marks the most ancient strata in which the proofs of sedimentary or aqueous action are still visible, notes the geological position of those beds which offer the first ascertained signs of life," and shows us, "that geology, modern as she is among the sciences, has revealed to us, that during cycles long anterior to the creation of the human race, and while the surface of the globe was passing from one condition to another, whole races of animals, each group adapted to the physical conditions in which they lived, were successively created and exterminated."—(*Siluria, by Sir Roderick Murchison.*)

The Secondary or Mesozoic series of strata, including the

New Red Sandstone or Trias, the Liassic and Oolitic formations, the limestone, sands and clays of the Wealden, the Green Sand, the Gault and the Chalk, follow next in order and the tertiary formations, from the Plastic Clay to the Hempstead beds, will be found upon the eastern portion of the country which has been examined by the Geological Survey. All the known varieties of rock formation, with the exception of a few more recent than the Hempstead beds of the Isle of Wight, are found within the above-named series. The amount of information thus conveyed will be evident to every one inspecting this work. In addition to this, the metalliferous lodes or veins are marked in gold lines, and the deposits of stream tin by gold dots; the outcrops of the coal beds are distinctly indicated by black lines, and the faults or dislocations, a knowledge of which is so important to the miner, are marked in white lines.

The metalliferous contents of each mineral vein are told by the use of the old chemical signs, and arrows indicate by their direction the dip of the strata, and of the coal beds—thus is included a large number of facts which, independent of their high scientific importance, are of the utmost practical value.

THE HORIZONTAL SECTIONS show the order of position in nature of those geological formations, as they would be exhibited to us, if an extended cutting, such as we see in our railways, was made across the particular lines of country which correspond with these sections. The uniformity of the scale for height and distance, which has been maintained, enables the observer, at a glance, to see the physical character of a district, at the same time as he can study the geological peculiarities.

The maps of the Geological Survey are on the scale of 1 inch to a mile.

The Horizontal sections are drawn to a scale of 6 inches to the mile, horizontally and vertically.

THE VERTICAL SECTIONS, in the form of a vertical column, are to a scale of 40 feet to an inch, and illustrate such details as it is impossible to give in the horizontal sections—for example, with coal measure sections, the thickness of each bed of coal, the mineral structure and thickness of the interlying strata, and kind and amount of ironstone, are given in great detail.

On the eastern side there is hung a map of all those portions of Ireland which have been geologically surveyed; and on the opposite, or on the western wall, a map of Lancashire, on the scale of 6 inches to the mile. On the southern side of the Horticultural entrance is a Geological Map of a part of Scotland, on the scale of 6 inches to the mile; and on the side wall another map on the 1-inch scale of the same district.

The Geological Survey was commenced, in 1835, by Sir Henry Thomas de la Beche, with whom also originated the Museum in Jermyn Street, in which the mineral wealth of the British Isles is fully illustrated. This building, in the words of the present Director-General, "stands forth as the first palace ever raised from the ground in Great Britain, by the Government, which is entirely devoted to the advancement of science."

The progress of the Geological Survey, now under the guidance of Sir Roderick Impey Murchison, the present Director-General, is indicated by the large Maps which adorn the walls of the Eastern Annex.

SUNDRY MAPS AND MINING PLANS.

Sir Richard Griffith exhibits his Geological Map of Ireland. Mr. Salter, of the Geological Survey, proposes a new system of colouring Geological maps, founded on the arrangement of rays in the prismatic spectrum: he shows a Geological Map of England so coloured. Mr. Mylne exhibits his Geological Map of England, and a Map of the tertiary and cretaceous districts of England and the north of France, Belgium, Holland, and Denmark, with the coal-field areas and contours of the adjacent seas.

In addition to those there is a very large plan of Holmbush Mine, illustrating the instructive model of that mine by Mr.

Jordan, which is placed near it. Mr. Henderson sends plans and sections of several of the Cornish mines. Mr. Sopwith has a sectional illustration of the strata at Allenheads, showing the run of the great Blackel level, which is to be seven miles long, now in process of excavation. The neighbouring district of Weardale is illustrated by a model, and a section by Robinson and Son.

The Durham and Northumberland coal trade have hung many maps illustrative of that great coal-field, and modes of working; while Mr. Mark Fryar sends, from the School of Mines at Glasgow, a plan of coal mine, and ventilating arrangements, executed by the students—working miners at that excellent school. Other plans and sections will be found in the Class, which may be studied with great advantage in connection with the models and specimens exhibited.

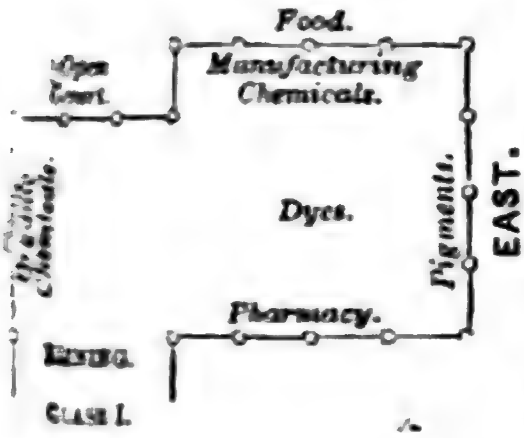
This Class contains many objects of the first importance to this country. It must be admitted that they are not, generally, of an attractive character; but they represent the treasures of that national store-house, from which we draw annually minerals having the value of

£32,183,600,

and on which the position of England in the scale of nations depends.

CLASS II.—CHEMICAL AND PHARMACEUTICAL PRODUCTS.

SITUATION OF CLASS.—*In the Eastern Annex, beyond the Mining Class, between the pillars* (A 37), (B 37), *and* (C 37), *and* (A 40), (B 40), *and* (C 40).



Position of Groups.—On the left, on entering, are the rarer organic compounds; Pharmaceutical preparations being on the right. Dyes and allied substances take the central position, followed by Pigments. Chemicals are spread over every division of the Court.

In describing the products of this Class the following classification will be adopted:—

CHEMICALS USED IN MANUFACTURES: FINE CHEMICALS AND RARE PRODUCTS: DYES, PIGMENTS, AND VARNISHES: PHARMACEUTICAL CHEMICALS AND DRUGS: MISCELLANEOUS CHEMICAL MANUFACTURES.

CHEMICALS USED IN MANUFACTURES.

SULPHURIC AND OTHER ACIDS.

Exhibitors.—C. Foot and Co. (518), Hirst, Brooke, and Tomlinson (528), W. J. Kane (548), E. Wood (628), Gaskell, Deacon and Co. (520), Cox and Gould (502), Melincrythan Chemical (566). Co.

This acid is made by admitting, simultaneously, into a leaden chamber containing water, sulphurous acid, produced by burning sulphur, nitrous acid vapours, atmospheric air, and jets of steam. Sulphuric acid is of the utmost importance in chemical manufactures, for by its aid many other chemical substances are produced. By mixing it with nitre, and distilling at a gentle heat, *nitric acid* passes over, and by substituting common salt for nitre, we obtain *hydrochloric acid*.

BORACIC ACID.

This substance is manufactured in large quantities, from the volcanic fumaroles of Tuscany. The first locality known was at *Sasso*, whence the name *Sassoline*, sometimes applied to native boracic acid. The lagoons of Tuscany spread over a surface of about thirty miles, and clouds of vapour are constantly seen rising in large volumes among the mountains. As they are approached, the earth appears to pour out boiling water, as if from volcanoes of various sizes, the heat in the immediate neighbourhood is intolerable, and the vapours suffocating; the vents for the vapour are termed *Suffioni*. These hot vapours consist principally of boracic acid; they are made to pass through water, by which the acid is absorbed. These waters are evaporated by means of the steam from the springs, and they yield from seven to eight thousand pounds troy per day. These works are in possession of Count Larderel. Great quantities are sent to this country to be made into *borax* or *biborate of soda*. Borax is also made from *borate of lime*, which occurs native in Peru. This mineral, called *Hayescine*, has been within the last few years imported into Liverpool from Peru.* Hayescine is a *borate of lime*, the specimens exhibited having a composition of boracic acid 45·46, lime 14·32, soda 8·22, potash 0·51, sulphuric acid 1·10, chloride of sodium 2·65, sand 0·32. It occurs over the dry plains of Iquique, in Southern Peru, in white reniform masses, from the size of a hazel nut to that of a potato, where it is called *tiza*. *Tincal*, an impure biborate of soda found in Thibet, China, and Persia, is also used in the preparation of borax. It contains many impurities, which are got rid of by treating the crude material with lime water, and chloride of sodium. Borax is much used in the manufacture of certain kinds of glass, in glazing stoneware, in smelting ores, and in soldering.

Our imports for some years have averaged as follows:—

	Cwt.
Boracic acid - - -	26,000
Refined borax - - -	6,500
Tincal - - - -	13,650

The value being 138,370*l*.

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* See Case of Liverpool imports in Central Avenue.

ACETIC ACID.

This acid is one of the products of the dry distillation of wood, hence it is often known in commerce as *pyroligneous acid* or *wood vinegar*. The weak acid, containing five or six per cent. of the pure acid, is used as vinegar. The concentrated or glacial acetic acid, so called from forming a solid mass like ice, at ordinary temperatures, is made by distilling acetate of soda with sulphuric acid; by which process sulphate of soda is formed, and pure concentrated acetic acid passes over. Glacial acetic acid is largely used in photography.

IODINE—ITS SALTS.

Exhibitors.—**Cox and Gould (502), J. Ward and Co. (619), E. C. C. Stanford (607), Hopkin and Williams (530), W. Huskisson and Sons (536).**

This is an elementary substance, procured from the mother-liquor of kelp. The chemistry of sea-weeds may be pleasingly and instructively studied, by reference to the Case exhibited by E. C. C. Stanford. Iodine was discovered in 1812 by Courtois, a French chemist, and was at first only used in pharmacy. Of late years it has received an important application in the arts, being now one of the principal materials employed in photography. The soluble iodides, *iodide of potassium*, *iodide of cadmium*, and *iodide of ammonium*, being the principal salts employed for this purpose.

PHOSPHORUS.

Exhibitors.—**Albright and Wilson (460).**

This elementary body is largely used in the manufacture of lucifer matches. It is made by mixing certain proportions of bone ash, oil of vitriol, and water, and agitating them for some time; the liquid which then contains acid phosphate of lime, is strained through linen, concentrated to a thick syrup and afterwards mixed with sufficient charcoal to give it a doughy consistence. The mass is strongly heated in an iron vessel, being kept continually stirred until properly dry, and

H 2

afterwards transferred to an iron or stoneware retort, the tube of which dips into water. Gentle heat being applied, phosphorus distils over mixed with charcoal and other impurities, from which it is freed by being melted under water and pressed through chamois leather; it is then cast in long sticks or wedge-shaped masses.

AMORPHOUS PHOSPHORUS.—This extraordinary substance is phosphorus in an altered molecular condition. Its peculiarities have been fully investigated by Dr. Schröetter, of Vienna. By melting the ordinary phosphorus in an atmosphere devoid of oxygen or moisture, and regulating the heat steadily between 450° and 460°, for thirty or forty hours, the whole of it will become converted into the amorphous variety. Amorphous phosphorus is much harder and less inflammable than the ordinary form; it emits no odour, and is insoluble in bisulphide of carbon, ether, and naphtha. If heated to 600°, it is immediately transformed into ordinary phosphorus, bursting into flame during the process. The specimens exhibited are black and solid; but by keeping the temperature at the maximum during its conversion, a red pulverulent variety is obtained, which rivals vermilion in brilliancy of colour. If rubbed with chlorate of potash, it detonates, a slight amount of pressure being sufficient to produce the effect. It must be remembered that this very extraordinary change is not connected with any chemical alteration; it is dependent entirely upon some physical differences which our science does not enable us to explain. When the ordinary form of phosphorus is used in the lucifer-match manufactories, a terrible disease afflicts the work-people engaged. The cartilaginous and bony parts of the body are diseased and softened in a melancholy, curious way. The introduction of the amorphous variety would remove this lamentable affliction. (See *Lucifer Matches.*)

ALKALIES AND THEIR COMPOUNDS.

CARBONATE OF SODA.

Exhibitors.—C. Allhusen and Son (461), Chance Brothers and Co. (495), Gaskell, Deacon, and Co. (520), Hirst, Brooke, and Tomlinson (528), Hutchinson and Earle (537), Jarrow Chemical Co. (540), Muspratt Brothers and Huntley (571), Roberts, Dale, and Co. (588), Walker Alkali Co. (615), F. O. Ward (617), I. L. Bell, (473), F. Versmann (613).

One of the most important of English chemical manufactures, is that of carbonate of soda from chloride of sodium (common table-salt). Up to the year 1823, nearly all carbonate of soda was made from *barilla*, a substance procured by burning the *salsola soda*, a plant much cultivated on the coast of Spain, the Islands of Sicily, and Teneriffe, and on the coasts of Scotland and Ireland.

The history of our soda manufacture has been so ably written by Mr. William Gossage that I am induced to make copious extracts from his pamphlet, on this important industry.

"The whole art of the extraction of soda from common salt having been made patent to the French community by its publication, in 1797, in the *Annales de Chimie*, it would appear extraordinary that so many years should have elapsed before these processes were adopted in our own country. This was occasioned by the duty of £30 per ton on salt, which continued to exist until 1823, eight years after the restoration of peace.

"In 1774, the Swedish chemist, Scheele, was the discoverer of chlorine, (then called oxymuriatic acid) also of its property to destroy vegetable colours. This property was studied by the French chemists, Lavoisier and Berthollet, who succeeded in founding upon it a successful process for bleaching linens.

"This process was brought over to Scotland in 1787 by Professor Copeland, of Marischal College, Aberdeen, and in the following year a large bleaching establishment was formed near Bolton, founded upon the employment of this process. Thus was commenced the application of one of the many discoveries contributory to the establishment of the great 'Cotton Trade,' which has done so much to provide employment and create wealth for the inhabitants of this county.

"Previously to the use of chlorine, bleaching was effected by the exposure of fabrics to sunlight and air, and nearly all goods requiring to be bleached for this country were sent to Holland or Germany.

"It is obvious that without the discovery of some more rapid method than the former one, we should have been compelled either to do without bleached fabrics, or without the existing and astounding cotton manufacture.

"In the first instance, chlorine was used in the state of solution in water, but in this form its use was attended with inconvenience to the workmen. This was remedied by the addition of potash to the water, producing a solution called 'Eau de Javelle' by the first makers of it.

"The next step was to substitute lime for potash, thus producing solution of chloride of lime. This was the idea of the late Mr. Charles Tennant, of St. Rollox, who was a bleacher. In Mr. Tennant's process large quantities of sulphate of soda were formed, and, owing to excise restrictions, this was thrown away as water. This was, however, eventually employed as the source from which soda was obtained.

"During this period, the late Mr. W. Losh (who has recently died at the patriarchal age of 91) was making crystals of soda by Le Blanc's process, and this gentleman may be considered as the father of the soda-trade in this country. Mr. Losh was resident in France when the French Republic was established, and had to fly from thence with others of his countrymen. On his return to this country, he commenced some experiments, at Walker, on the River Tyne, for the manufacture of soda-crystals, (which were then obtained from kelp, and sold at £60 per ton, the present price being £4 10s., or about one fourteenth part); and during the short peace of

Amiens, in 1802, he again visited France, and obtained a more complete knowledge of Le Blanc's processes.

"After Mr. Losh's return, he applied to Government for permission to avail himself of a spring of weak brine (which he had discovered to exist at Walker) for the manufacture of soda, and having been permitted to use this, without any payment for salt duty, and having associated himself with Lord Dundonald, Lord Dundas, and some other gentlemen, he proceeded to erect a vitriol chamber, and to apply sulphuric acid to the decomposition of salt contained in the weak brine, so as to produce sulphate of soda, and from this to manufacture soda-crystals by Le Blanc's process.

"Notwithstanding these previous essays, 1823 may be considered as the NATAL YEAR of the soda-trade. In that year, common salt being relieved from fiscal impost, Mr. James Muspratt commenced the erection of works at Liverpool, wherein salt was decomposed by sulphuric acid, specially for the production of sulphate of soda to be used for the manufacture of carbonate of soda."

In the process of decomposing common salt with sulphuric acid, immense quantities of hydrochloric (muriatic) acid is given off, destroying all vegetation if allowed to escape into the air. It is now condensed. This is effected by a plan patented in 1836, by Mr. Gossage.

The *salt cake* obtained by this process is mingled with chalk and powdered coal, and thrown in quantities of two hundred-weight and a half at a time, into a hot reverberatory furnace, and frequently stirred until the whole is melted. When cold, the melted mass consists of about twenty per cent. of pure soda, mixed with unburned coal, and oxysulphide of lime. From its appearance, this material is called *black ash*. To extract the soda from it, it is lixiviated in warm water, in vessels with false bottoms. The insoluble residue contains nearly the whole of the sulphur compounds together with the excess of lime and coal. Of late years, many improvements of great importance have been introduced into Le Blanc's process, although it remains the same in principle.

One of the latest and most valuable of these is the process of Mr. Longmaid, in which common salt is decomposed by fusion with iron pyrites. Large quantities of the latter material are obtained from British and Irish mines, especially from those of Cornwall and Wicklow; we have also imported considerable quantities from Spain and Portugal for this purpose.

The specimens of carbonate of soda or common washing soda exhibited, are both numerous and excellent; the display of this particular branch of manufacture being one of the great features of this year's Exhibition. Fine masses of soda crystals, in nearly perfect rhomboidal prisms, many inches in length, may be seen in several cases, manufacturers being apparently desirous of showing, by this means, the great purity of this important product. Carbonate of soda is transformed into the *bicarbonate*, by being confined in an atmosphere of carbonic acid. The gas is gradually absorbed, the crystalline masses becoming friable and opaque during the process. There are many fine specimens of soda crystals, carbonated in this way.

There are now fifty establishments in Great Britain in which soda is manufactured by Le Blanc's process, producing

about	3000	tons	of Soda-Ash	per week.
„	2000	„	of Soda-Crystals . . .	„
„	250	„	of Bi-Carbonate of Soda	„
„	400	„	of Bleaching Powder .	„

The total annual value of these products may be estimated as exceeding two millions sterling, which is so much entirely added to the annual income of the country, excepting about 100,000*l*. paid for materials obtained from other countries.

The number of workmen, actually employed in the several manufactories, may be estimated as being at least ten thousand, exclusive of those engaged in the manufacture of salt, and in mining for pyrites, limestone, and coal; also exclusive of the men engaged in the transport of raw material and manufactured goods by sea, canals, and railroads.

By the existing mode of working, there is required for the production of a ton of Soda-Ash, the following raw materials :—

1¼ Tons of Irish Pyrites, costing		£1	15	0
1 Cwt. Nitrate of Soda	,,	0	12	0
1¼ Tons of Salt	,,	0	10	0
1½ Tons of Limestone	,,	0	10	0
3½ Tons of Fuel	,,	1	1	0
		£4	8	0

The other charges consist of interest on capital, wages, repairs, packages, freights, &c., &c. At the present moment, the soda trade is suffering from great depression of demand and price, consequent upon the unfortunate war in the, formerly, United States.

Caustic Soda.—This is made by dissolving the crystallized carbonate in water, and adding milk of lime. It forms the alkaline ley of the soap-boiler, and, by careful evaporation, the solid caustic soda can be obtained. Caustic soda is also one of the principal ingredients in the manufacture of glass.

Phosphate of Soda.—This salt serves to replace the offensive mixtures used in the operations of dunging in calico-printing.

Stannate of Soda.—This salt, which is much used as a mordant in dyeing, is made by acting on oxide of tin by caustic soda, by a process patented by Mr. Young. This process presents a very beautiful application of science. Instead of reducing metallic tin from the ore, and oxidating the metal again to form the stannic acid at the expense of nitric acid, Mr. Young takes the native peroxide of tin itself, and fuses it with soda. The iron and other foreign metals present in the ore are insoluble in the alkali, so that by solution of the fused mass in water, a pure stannate of soda is obtained at once. It is crystallized by evaporation, and obtained in efflorescent crystals containing nine equivalents of water.

Tungstate of Soda.—This salt, which has been lately introduced as a means of rendering articles of clothing uninflammable, is formed by the union of tungstic acid and soda, the acid being a peroxide of the metal tungsten. Numerous salts were tried for the purpose above-mentioned, but none appeared to answer the purpose so well as the salt described. (*See* HANDBOOK, Part I.)

SILICATE OF SODA.—This compound is used as a substitute for dung in calico-printing, and in place of resin by soap manufacturers. It is also largely employed in the manufacture of artificial stone and for preserving stone. This will be fully dealt with in connection with Class X.

HYPOSULPHITE OF SODA.—This salt is extensively used by photographers as a fixing agent, having been introduced for that purpose by Sir John Herschel. It is also employed by bleachers to extract the last traces of chlorine from fabrics, and especially from paper. See *Photography*, Class XIV.

ALUMINATE OF SODA.—This salt is coming into use as a substitute for alum in certain printing and dyeing operations.

SODIUM.

Exhibitor—I. L. Bell (473).

This metal, which until lately was a chemical curiosity, is now manufactured in large quantities as a commercial article, for the purpose of reducing aluminium from its compounds. Some very beautiful examples may be seen in a crystalline form in this case.

This metal was discovered by Sir H. Davy, almost immediately after potassium, and obtained by the same means, viz., by exposing a piece of moistened hydrate of soda to the action of a powerful voltaic battery, the alkali being placed between a pair of platinum plates connected with the battery.

By this process only very small quantities could be obtained. The demand for sodium in the manufacture of aluminium by the process of M. St. Clair Deville, has led to a large demand. The process now adopted is the same as that for obtaining potassium; an intimate mixture of carbonate of soda and charcoal is made by igniting in a covered crucible a salt of soda containing an organic acid, as the acetate of soda, &c., or by melting ordinary carbonate of soda in its water of crystallization and mixing with it, while liquid, finely divided charcoal, and evaporating to dryness; this mixture is mixed with some lumps of charcoal and placed in a retort, which is generally made of malleable iron, but owing to the difficulty of getting these sufficiently large, earthenware or fire-clay retorts have been used with success, and sometimes these are lined with or contain a trough of malleable iron. These retorts are so placed in a furnace that they are uniformly kept at a heat approaching to whiteness, and sodium distils over. The receiver contains rock-naphtha, and is surrounded by cold water. The sodium which comes over is mixed with some impurities; and in order to separate the metal from these, the sodium is melted under mineral naphtha, in a cylinder, into which is fitted a piston, worked by a screw or hydraulic press, and when this is forced down the metal forms in a mass above it, while the impurities remain at the bottom of the cylinder.

Sodium is a silver-white metal; it is so soft at ordinary temperatures that it may be easily cut with a knife or pressed between the finger and thumb; it melts at 194° F., and oxidizes rapidly in the air. When placed upon the surface of cold water it decomposes it with violence, but does not ignite the hydrogen which is liberated, unless the motion of the sodium be restrained. When a few drops of water are added to sodium the hydrogen liberated immediately inflames, and such is also the case if sodium be put on hot water; when burning it produces a yellow flame, and yields a solution of soda.

POTASH.

Caustic Potash, or Hydrate of Potash.—Hydrate of potash is the most powerful alkali we possess. In commerce it occurs in masses of different shapes, often of a light bluish-green colour, from containing a small portion of manganate of potash. It is extensively used by the soap-maker in the preparation of soft soap, a compound possessed of very powerful detergent properties. It is applied in surgery as a caustic.

Chlorate of Potash.—The intense oxidizing power displayed by this salt renders it particularly valuable to the chemist. It has been used for gunpowder, but its use has been abandoned, owing to the liability of the compound to explode by friction. There are two ways of preparing this salt, one by passing a current of chlorine through a solution of carbonate of potash; the other, which is now almost universally used, was introduced by Mr. James Young.

Chlorine gas is passed through caustic lime, in suspension in hot water. By this means bleaching liquor is formed; but as soon as the chlorine is added in the smallest excess, the bleaching properties cease, and chlorate of lime is at once produced. If chloride of potassium or sulphate of potash be added to this solution, chlorate of potash may be crystallized out. In this process there is a saving caused, 1st, by using no carbonate of potash or caustic potash, which are much more expensive than chloride of potassium or sulphate of potash; 2ndly, by transferring the oxygen to the lime, before using any potash salt, and forming chloride of calcium as a waste product, instead of chloride of potassium. This beautiful salt crystallizes in lustrous diamond-shaped plates, is largely used in making lucifer matches, in conjunction with phosphorus, red lead, and gum. It acts in this instance by affording a large supply of oxygen to the inflaming phosphorus. It is also employed in making percussion tubes for cannon; and, as might be guessed, the pyrotechnist uses it in large quantities. Mixed with binoxide of manganese, and heated, it gives off large quantities of oxygen.

Nitrate of Potash.—This important salt, the commercial name of which is nitre, or saltpetre, is produced by lixiviating the soil of certain districts in the East Indies, where it occurs as an efflorescence on the soil. Artificial nitre beds are formed in various countries of Europe, by placing animal matter, mingled with ashes and lime rubbish, in heaps, which are watered from time to time with urine and stable runnings. The principal consumption of nitre is in the manufacture of gunpowder and fireworks. Nitrate of soda has lately been introduced, with apparent advantage and economy.

CARBONATE OF POTASH.—This salt is extracted from the ashes of land plants by lixiviation. The ley thus obtained is evaporated to dryness, the residue calcined; in which state it is known commercially as *potash* or pearlash. The fused mass contains about 60 per cent. of alkaline carbonate. It is much used in the manufacture of soap and glues as a detergent, and is the source of many salts of potash.

BICHROMATE OF POTASH.—This very important salt, which is extensively used in fabric-printing, dyeing, and colour-making, is produced by fusing chrome iron-ore reduced to powder, with half its weight of water, in a reverberatory furnace. Chromate of potash is formed, and is converted into bichromate, by adding sulphuric or nitric acid to the solution, which causes the abstraction of half the base.

PRUSSIATES OF POTASH.—There are two prussiates of potash, one crystallizing in fine brimstone-yellow masses, the other in purplish-red prisms. They are much used in dyeing, calico-printing, and colour-making. The process of manufacture is too long for description here. From the yellow prussiate of potash is made the cyanide of potassium, an exceedingly poisonous salt, used by photographers and electroplaters.

POTASH.—*Extracted from its sources in the Primitive Rocks*, by Ward and Wynants, No. 617. This is concisely described by the inventor as follows:—

"The felspar, or other natural alkaliferous silicate which it is proposed to treat, is finely ground, and mixed with a due proportion (to be stated presently) of fluor spar, also in powder. With this mixture a certain quantity of chalk or lime (or, preferably, of a mixture of the two) is incorporated. The mass thus prepared, either in its dry pulverulent condition, or, preferably, made up with water into mortar-like balls or cakes (of hydrated basic carbonate of lime, holding the felspar and fluorspar diffused therein, as extraneous grit is diffused in mortar), is ignited at a cherry-red heat, or thereabouts, till the ingredients become lightly fritted together; an effect obtainable in an hour or less. The resulting porous frit is boiled, or methodically lixiviated with hot water, which, in half an hour or less, dissolves out the *whole* of the alkali previously existing in the felspar. The alkaline solution thus obtained usually holds in solution a proportion of silica or alumina, but it contains no ingredient not readily separable by lime; so that caustic or carbonated potash may be obtained at the operator's choice, by the usual means. The exhausted frit contains, of course, the silica and alumina of the felspar, with any lime or magnesia, or other earthy bases, it may contain, as also the whole of the added earthy base. The residuum is not a waste, like that of the soda process; it serves a purpose as a cement."

CHLORIDE OF LIME.

Exhibitors.—**Allhusen and Sons (461), Jarrow Chemical Co. (540), Muspratt, Brothers, and Huntley (571), Gaskell, Deacon, and Co. (520), J. Shanks (598).**

This important bleaching and deodorizing agent may be said to have been the means of making England the leading European manufacturing country, for by its successful manufacture alone, we are able to bleach for market the thousands of miles of cotton fabrics made in this country annually. An interesting series of substances, illustrating its manufacture, will be found in Case 598. Its properties as a deodorizer are so well known, that they need not be recapitulated here. It is often called a disinfectant; it possibly may be so, and it certainly deserves the name beyond several other things to which the term is applied, in our very careless habit of applying general terms. The public, however, should be fully informed upon this. Because offensive smells are removed by the use of a chemical agent, it should not, as a necessary consequence, be inferred that miasma—or any organic poison capable of producing disease—are therefore removed. The smell being destroyed by no means proves that the poison is rendered harmless, as there are organic poisons devoid of smell. Chloride of lime is made by passing a current of chlorine gas over a quantity of fresh lime, and chlorine appears to be destructive on organic substances.

ALUM.

Exhibitors.—F. B. Baker (467), Bray and Thompson (485), Hurlet and Campsie Alum Co. (535), Metropolitan Alum Co. (567), P. Spence (605), J. Wilson and Sons (626), Muspratt, Brothers, and Huntley (571).

Alum is a salt consisting of alumina—or the earth which forms one of the constituents of clay—in combination with sulphuric acid, and these are again united with sulphate of potash or ammonia. Alum, indeed, is a double salt, consisting of sulphate of alumina, with either sulphate of potash or sulphate of ammonia.

Alum exists in nature as sulphate of alumina, in alum shale, and several other minerals. It is made largely on the coast near Whitby, along which the alum shale exists in connection with the jet beds.

This important salt is used by calico-printers and dyers both as a mordant and as a chemical agent to determine the colour of some tinctorial substances.

In 1844, Mr. Spence turned his attention to the practicability of producing alum from the shale of the coal measures, a mineral brought up largely from our coal mines, but up to that period entirely useless. After much labour he invented a successful mode of effecting this, by calcining the shale, and subsequently digesting it at a heat of 220° Fah., in diluted sulphuric acid; by this means obtaining from the shale only one, but the distinctive constituent of the alum—the argil of the early chemists, the alumina of the present nomenclature, being, in fact, the oxide of the new metal, aluminium. This process Mr. Spence patented in 1845, and commenced the manufacture, on a scale of some magnitude. For the first five years the manufacture was a losing one, several thousand pounds being lost on it in that period. Subsequent improvements in the process were made, and also patented; the last of these was in 1859, for directly combining ammonia, in the gaseous form, obtained from the liquor of the gas-works, with the sulphate of alumina, in the process of digesting. The varied improvements made changed the manufacture from a losing to a profitable trade, although, in 1845, 10*l.* per ton was obtained for the alum, when sold, and 6*l.* per ton is the present price in England, with no probability of its being higher, but lower.

SULPHATE OF COPPER.

Exhibitors.—Bouck and Co (481).

Some magnificent crystals of this beautiful salt in gigantic rhombic masses are to be seen in this case. They are manufactured by a patent process directly from copper ore (*sulphide of copper*), instead of from old copper sheathing and other waste metal, as was formerly the case. The economy of the old process, as compared with the new, is great, and the size of the crystals shows the perfection of the process.

CHLORIDE OF TIN, OXIDE, &c.

Exhibitors.—Haworth and Brooke (527).

These salts are used as mordants in dyeing and printing, especially in Turkey red, and scarlet dyeing.

NITRATE OF LEAD.

Exhibitors.—Bouck and Co. (481), Roberts, Dale and Co. (588).

This salt is used in dyeing and printing, and as a source of chromate of lead, which is of a fine golden-yellow colour.

CHLORIDE OF GOLD AND NITRATE OF SILVER.

Exhibitors.—Davy, Mackmurdo, and Co. (505), Johnson and Sons (541)

These two salts are extensively used by photographers; the former as a toning agent to change the colour of the paper print, the latter in the preparation of sensitive surfaces.

BENZOLE.

Exhibitors.—D. Dawson (506), R. Holliday (529), G. Shand (597), Simpson, Maule, and Nicholson (600).

(*Syn.* Benzine, benzene, hydruret of phenyle $C^{12}H^6$). The more volatile portion of coal naphtha has been shown by Mansfield to consist chiefly of this substance. It is produced in a great number of reactions in which organic bodies are exposed to high temperatures. It may at once be obtained in a state of purity by distilling benzoic acid with excess of quicklime. The lime acts by removing two equivalents of carbonic acid from the benzoic acid. It is obtained, however, in general from coal naphtha. Ordinary coal naphtha is procured by the distillation of coal tar. The latter is placed in large iron stills, holding from 800 to 1500 gallons, and distilled by direct steam. As soon as the specific gravity of the distillate rises to 0·910, the naphtha is pumped into another still, and distilled with direct steam until the distillate again becomes of the density 0·910. It then constitutes what is termed "rough naphtha."

The residue obtained in the first distillation is run off into cisterns or tar ponds to allow of the removal of the water. This residue is called boiled tar. Pitch oil may be obtained from it by distillation with the naked fire; every 1000 gallons will yield about 320 gallons of pitch oil. The residue of pitch in the still, is run out while in a melted state. The rough coal naphtha contains a great number of impurities of various kinds. To remove these, the naphtha is transferred to large cylindrical vessels lined with lead, and subjected to redistillation with certain precautions.

From this the benzole is obtained by careful distillation, in peculiarly constructed stills, which allows all hydrocarbons that are volatile at 212° to pass over, returning back the others into the crude mass. To render benzole perfectly pure, it is frozen—when it forms a beautiful snow-white substance resembling camphor.

Benzole has been much used of late for removing grease and fatty matters from wool, silk, and mixed fabrics. Mr.

Craco Calvert has patented an application of benzole to some purposes of this kind.

The products from coal show, more conclusively than any other of the results obtained by chemists, the value of this science, whether regarded in its philosophical or commercial relations. M.M. Laurent and Casthelar have given a table showing what chemistry has done in this direction:—

	Fr.	Cents.	
1. COAL – – – –	0	4	Per kilogramme = 2 lbs. 3¼ ozs.
2. Tar – – – –	4	10	„ „
3. Heavy oil – – –	0	20	„ „
4. Light oil – – –	1	25	„ „
5. Benzole – – –	2	50	„ „
6. Rough nitro-benzole	7	0	„ „
7. Rectified ditto – –	12	0	„ „
8. *Ordinary aniline* –	45	0	„ „
9. Violet carmine aniline	75	0	„ „
10. Pure aniline violet, in powder, 3000 to 4000 fr.			„ „

Thus, with coal carried to its tenth power, we have reached the price of gold. (See *Aniline.*)

Naphtha and naphthaline have not yet received any important applications; but lately M. Roussin has communicated a process by which very fine colours can be obtained from naphthaline.

"Naphthaline," says a recent writer, "at one time the curse of the tar distillers, will become an article of vast importance, although formerly it was frequently the case that they were compelled to bury this unprofitable acquaintance."

FINE CHEMICALS AND RARE SUBSTANCES.

Exhibitors.—Bolton and Barnitt (479), A. H. Church (497), W. Crookes (503*a*), De la Rue and Muller (507), J. Hulle (533), W. Kane (548), Morson and Son (570), J. Stenhouse (608), T. and H. Smith (604).

These are numerous, and have more interest for the chemical philosopher than for the general public. It will be sufficient to notice a few of the most prominent products. The collection of bile products in Case 503, are extremely interesting and beautiful. This case contains many curiosities in this way, such as a piece of iron made from the blood of an ox. In Mr. Crooke's Case is a specimen of the supposed new metal, *thallium*, lately discovered by this gentleman by means of Spectrum analysis, in the same manner as Bunsen and Kirchoft discovered *Cæsium* and *Rubidium*. Although the interesting nature of the inquiry into the spectral images produced by coloured flames has led to a tolerably extensive acquaintance with the phenomena, it appears necessary to give a brief explanation of the experiments which led to the discovery of these metals.

If any salt of soda is burnt in a flame it gives a yellow light, and, if a beam of this monochromatic light is passed through a prism it produces a well-defined yellow line. The red flame of strontian gives a well-defined series of red lines, lithium another set, and thus it is found that every substance produces its own peculiar spectral image. Bunsen, on examining the alkalies contained in the waters of Durkheim, in Rhenish Bavaria (he had previously separated, by chemical means, all the other bodies from the water, and the substances which were left could only be alkaline substances), saw, on looking at the spectra produced by these, some lines which he had never seen in the spectra of any alkalies before. Now, in a very interesting paper on these two new metals, which he calls rubidium and cæsium—cæsium from *cæsius*, a greyish colour, and rubidium, from *rubidus*, red, owing to lines of these colours being characteristic of the presence of these two metals. Bunsen says, that from 30 grammes of the mother liquor, he obtained only 1·2 milligrammes of the impure salts of these two new alkaline metals. That was all he had to begin with—about the one-hundredth part of a grain; but still, so sure was he of this method, and so certain was he that his spectrum never failed him, that he set to work at once, and evaporated down 50 tons of this water to get some more of this substance; 44 tons yielded him only 105 grammes of the chloride of rubidium, and 70½ grammes of the chloride of cæsium; so that out of 44 tons of water, he got only about 200 grains of the mixed chlorides of these two new metals.

The case of Dr. Stenhouse contains a very choice collection of the proximate principles discovered by him in the lichens and algæ, with other rare chemicals, the result of his unwearying researches.

Mr. Church, contributing, as the result of his industrious chemical inquiries, a curious collection of the rare vegetable acids, such as tolnic acid, suberic acid, picric acid, and their salts, with many others.

In a small case (533), Mr. Hulle exhibits a series of the vegetable alkaloids and their salts, such as strychnine, and the like. It has seldom happened that the public have had the opportunity of seeing in such quantities, those, in most cases, deadly poisons, obtained from the vegetable kingdom. Mr. Squire (666) also exhibits very beautiful specimens of these salts.

The products from opium—a tolerably extensive series; the alkaloids yielded by the aloe tribe—and caffeine, are exhibited by T. and H. Smith. *Caffeine*, an alkaloid containing nitrogen, is found in coffee. According to Liebig, a pound of the following coffees contain the proportions given of caffeine:—

Martinique . . .	32	grains
Alexandrian . . .	22	,,
Java	22	,,
Mocha	20	,,
Cayenne	19	,,
St. Dominique . .	16	,,

This substance is also found in tea; when obtained from it, it is known as *Theine*. It is found to exist in Hyson in the proportion of from 2·5 to 3·4 per cent.; in gunpowder tea from 2·2 to 4·1; in Paraguay tea, or, as it is called in Brazil, *Matte*, and in Guarana tea it exists in the proportions of 0·13 per cent. Good examples of *Matte* will be found in the Brazilian Court, where there is also a fine collection of teas of Brazilian growth.

The volatile organic acids and their ethers, exhibited by J. E. Barnes, are of great interest; and the collection of essential oils and fruit essences, by E. F. Langsdale, are no less so. It is a curious fact that all the vegetable infusions which have been adopted as common drinks by man contains either this or a similar alkaloid principle.

PARAFFIN.

Exhibitor—J. Young (632).

Paraffin was discovered by Reichenbach about the year 1830. Reichenbach saw its value, and tried to produce it in quantity, but always failed. About the year 1850 James Young discovered that paraffin, and an oil which he called paraffin oil, could be made in large quantities from coal. This discovery Young patented, and his products were first shown to the public in the great Exhibition of 1851, where they attracted the attention of the chemists of all countries. From the jury report we find the opinion that the great problem was realized which the rare sagacity of Liebig had pointed out ten years before. "It would certainly be esteemed one of the greatest discoveries of the age," says Liebig, "if any could succeed in condensing coal-gas into a white, dry, solid, odourless substance, portable, and capable of being placed upon a candlestick, or burned in a lamp." About the year 1851 a manufactory of those substances was begun at Bathgate, Scotland, by Mr. Young and his partners. This work has grown day by day, till it is now, we believe, the largest chemical work in the world. The solid white paraffin is sold to be made into candles, which are finer than the purest wax. The liquid products are sold for burning in lamps and for lubricating machinery. We may mention that no explosion has ever taken place with these oils—nothing being sent out from the works, for burning or machinery, which is not above the acknowledged standard of safety. The result of this care has been that, although millions of gallons have been used, not a single explosion has ever taken place with Young's paraffin oil, so that thousands of families have had a cheerful, pleasant light, cheaper than London gas, and none have received the slightest injury—a good example of the benefits that science confers on the community. This, like other inventions, has had many imitations, and the most dangerous substances have been sold under the name of paraffin oil. Mr. O'Neil reported to the Manchester Sanitary Association that he examined thirty-two samples of oil called paraffin oil. The whole of the samples which could be recognized, from their properties, as Young's paraffin oil, were safe. These amounted to eighteen; of the other fourteen samples two only were found quite safe. In fact, the value of the paraffin oil has caused many *to attach the name to the most volatile*, and therefore to the most dangerous naphthas. In Germany, too, the same desire for paraffin oil prevails; and in the Exhibition this product (paraffin oil) will be seen, procured chiefly from turf and brown coal, whilst the paraffin itself is exhibited as obtained from these substances, although made at a greater expense than at Bathgate. As a result of this discovery of Mr. Young's, the various petroleums and bitumens of the world have been sought out, and paraffin oil produced from them; Price and Co. sending ships as far as Rangoon, whilst the pitch lake of Trinidad has been tried, although with less success. The search for petroleum has resulted in the discoveries of the liquid rock oil in America, where the wells, so long known, had remained quite valueless. No one knows the ultimate result of this single discovery of paraffin and paraffin oil as a convenient method of conveying and using the illuminating principles of coal.

There are many other examples of the high perfection of our chemical manufactures which merit more than a casual inspection. To the great mass of the visitors, who necessarily have but a day or two at their command, and who desire to see, were it possible, everything within that limited period, the sketch which has been given will prove more than sufficient for their purpose. To any one, however, who visits this class with the more serious intention of profiting by the opportunity, it must prove quite insufficient. An extensive treatise would be required to do justice to one of the finest collections of chemical products which the world ever saw.

DYES, PIGMENTS, AND VARNISHES.

The most important of the dyes is undoubtedly the aniline or coal-tar series;—the lovely mauve and magenta, which have lately been so deservedly fashionable, belong to this class.

Aniline, and Aniline Dyes.

Exhibitors.—F. Allen (459), D. Dawson (506), Hirst, Brook and Tomlinson (528), Holliday (529), Judson and Son (547), Miller and Co. (568), Perkin and Sons (581), Roberts, Dale, and Co. (588), Rumney (592), Scott (596), Shand (597), Simpson, Maule, and Nicholson (600), Wilson and Fletcher (623).

Aniline is a colourless limpid liquid, of an agreeable vinous odour and burning taste, which may be produced in several ways. It was first formed by Unverdorben, by acting on indigo with hydrate of potash; and it takes its name from *anil*, an Indian word, applied to one of the plants from which indigo is obtained. It was afterwards found in small quantities among the products of the dry distillation of coal, but in 1856, Bechamp discovered a method of forming it from benzole, or benzine, as it is often called. Benzole is mixed with a certain proportion of nitric acid, which converts it into *nitro-benzole.* The nitro-benzole is then subjected to the action of acetate of iron,—in the form of acetic acid and iron filings,—and the resulting decomposition furnishes aniline in large quantities. Aniline is a base, and forms crystallizable salts with acids, which are analogous to those formed from the metals. The sulphate is the salt generally used in the manufacture of the dyes. Dr. Hofmann, by pointing out the test for the presence of aniline, led the way to the discovery of the new aniline series of dyes. The first worker in this direction was Mr. Perkin, who discovered mauve, or Perkin's purple, whilst endeavouring to make artificial quinine. Solutions of sulphate of aniline and bichromate of potash are mixed, and allowed to stand until the action is complete. A black precipitate is formed, which is washed with coal-tar naphtha and digested in alcohol. The alcoholic solution is evaporated to dryness, and the deposit formed is the colouring matter required. Aniline purple dissolves in alcohol, but is nearly insoluble in water, the hydrocarbons, and the ethers: in dyeing, an alcoholic solution, diluted with hot water, is used. Both silk and wool take this colour very perfectly, but the colour obtained in the case of cotton is far inferior to that obtained on animal substances. By treating aniline with the bichloride of tin, nitrate of mercury, or the chloride of carbon, very magnificent colours are formed, which are ordinarily known as *Mauve*, *Magenta*, &c. The investigations of chemists have made us acquainted with *Fuchsine*, or *Rosaniline*, *Indisine*, *Azaleine*, and other forms of Aniline, which are probably but modified states of each other. Acetate of rosaniline crystallizes in octahedra, possessing a metallic lustre, rivalling in effect the wing-cases of the most brilliant Indian beetles. The magnificent crown (Exhibitor, 600) made of this substance is very remarkable, not only for its real beauty, but for its intrinsic value, which is very great. Two other crowns of this beautiful salt have lately been added to this collection. Pure rosaniline when first prepared is perfectly white, but on adding to it acid of any kind, it immediately changes to the magnificent colour so well known. There are several other dyes made from aniline, but space will not allow of their description. The splendid collection of Mr. R. Rumney (592), illustrating the improvements made in calico-printing and dyeing since 1851, is wonderfully complete, and will fully repay a lengthened examination. It is impossible to overrate the importance of the coal-tar dyes to this country. From having the sources of the raw material in unlimited quantities under our very feet, we are enabled to compete most favourably with continental nations in this respect, and we shall soon become the great colour-exporting country, instead of having, as hitherto, to depend on Holland and other countries for our supply of dye-stuffs. Naphthaline, as already stated, which is analogous to benzole in many of its properties; has yielded some very fine dyes under peculiar treatment, but many obstacles appear to stand in the way of its being employed extensively.

DYES FROM LICHENS AND MADDERS.

Exhibitors.—Marshall, Son and Co. (563), Wood and Bedford (629), B. Smith and Son (601), Dr. Schunck (592), J. Stenhouse (608), Pincoffs and Co. (582).

The lichen dyes receive excellent representation. They are prepared by acting on the different species of lichens belonging to the families *Rocella*, *Variolaria*, and *Lecanora*, with carbonate of ammonia, carbonate of lime, or urea. The lichen dyes still keep a good position against the coal-tar series, although their consumption has of course much diminished since the introduction of the latter. The collection of definite principles obtained from lichens and madder, exhibited by Dr. Schunck and Dr. Stenhouse, are extremely interesting, and their discovery has thrown very great light upon this branch of applied chemistry. *Alizarine* and *garancine* are two very beautiful dyes, obtained from madder. To procure these substances, madder-root is reduced to coarse powder, treated with hot oil of vitriol, and well washed until the last traces of acid are removed. The undissolved mass when dried is used largely in print-works, under the name of *garancine*. Boiled with water the colouring matter is dissolved, and on adding sulphuric acid it is precipitated in an impure form. If the precipitate be sublimed, alizarine is obtained in beautiful orange-coloured needles.

LAC-DYE.

Exhibitors.—Marshall, Son and Co. (563).

This dye is very similar in its nature to carmine, being also furnished by a species of coccus; it is used as a substitute for cochineal, furnishing equally vivid and more permanent scarlets.

INDIGO.

Exhibitors.—Haworth and Brooke (527).

The most important of the blue dyes is Indigo, which is obtained from the leaves of various species of the *Indigofera*. The green plants are placed in troughs and covered with water; fermentation takes place, ammonia and carbonic acid being disengaged. The liquor is drawn off into other troughs, and a small quantity of lime is added; the mixture is stirred briskly, and the indigo separates as a deep blue granular powder, which is drained, pressed, cut into cakes, and dried. The indigo of commerce contains a brown and red colouring matter, which interferes with the pure blue of the indigotin or indigo blue. These impurities are separated by heating commercial indigo with caustic soda and grape sugar. The specimens of refined indigo exhibited by Haworth and Brooke are extremely pure and brilliant in colour, not a particle of the brown or red shade being perceptible.

The finest qualities of indigo are obtained from Bengal, the produce of that country having now taken the place in public estimation which was once occupied by that of the Spanish colonies. The export of indigo from Bengal, in 1853, amounted to 120,000 maunds (of 74 lbs. 10 oz. each), would require for its culture about 1,025,000 acres, and an annual expenditure of 1,300,000*l*. Of this extent of land about 550,000 acres are believed to be included in the Lower Provinces, and consist chiefly of alluvial land rescued from the rivers. The best qualities of Bengal indigo are manufactured in the Jessore and Kishenaghaur districts; but each district produces a quality peculiar to itself, and differences of a less striking character may be perceived in the produce of different factories. The Bengal indigo, when packed in chests, consists of four principal qualities, viz., the blue, purple, violet, and copper. But these kinds, by passing over into one another, produce a number of intermediate varieties, such as purply blue, blue and violet, purply violet, &c. The various qualities would, therefore, be distinguished as follows:—1. Blue. 2. Blue nd violet. 3. Purple. 4. Purple and violet. 5. Violet. 6. Violet and copper. 7. Copper. The finest qualities of Bengal indigoes present the following characteristics. They consist of cubical pieces, are light, brittle, of a clean fracture, soft to the touch, of a fine bright blue colour, porous, and adhering to the tongue. The lower qualities have a duller colour, assume more and more of a reddish tinge, are heavier, more compact, and less easily broken.

The indigo from the upper provinces of India comes chiefly from Tyroot, Oude, and Benares. It is inferior to Bengal indigo.

Of Madras indigo there are two kinds, viz.: 1. Dry leaf, made from dry stacked leaves; and 2. Kurpah, which is manufactured from the wet leaf in the same way as Bengal indigo. The latter has only come into use since 1830. Both are of inferior quality to Bengal indigo.

The Manilla indigoes present the marks of the rushes upon which they have been dried. The pieces are either cubical, or flat and square, or of irregular shape. The quality is very unequal. Java indigo occurs in flat, square, or lozenge-shaped masses, the quality approaching that of Bengal. Both these kinds are consumed chiefly on the continent of Europe.

Guatemala indigo is imported into this country in serons or hide wrappers, each containing about 150 lbs. net. It occurs in small irregular pieces, which are more or less brittle, compact, lighter than water, and of a bright blue colour with an occasional tinge of violet. There are three kinds of Guatemala indigo, viz.: 1. Flores, which is the best, and approaches in quality that of the finer Bengal indigoes; 2. Sobres; and 3. Cortes, which is the lowest in quality, being heavy, difficulty to break, and of a coppery-red colour. Of the first kind very little now reaches the market. The indigo of Caraccas is, generally speaking, inferior to that of Guatemala.

Our importations of indigo have been of late years as follows:—

Imports of Indigo for the Three Years ending 1860.

COUNTRIES WHENCE IMPORTED.	1858. Cwts.	1859. Cwts.	1860. Cwts.
British East Indies	55,867	51,561	65,941
French Possessions in India . .	1,509	559	2,625
Philippine Islands	378	..	..
Honduras British Settlements .	409	436	..
Central America	..	737	1,409
New Grenada	5,200	7,375	5,740
Venezuela	456	..	..
Peru	..	386	..
Chili	..	..	403
Other Parts	2,379	2,183	1,203
Totals . .	66,198	63,237	77,321

PIGMENTS.

Exhibitors.—J. Bailey (464), Blundell, Spence, and Co. (478), D. Cahn (491), S. Calley (492), Dr. Cattell (494), Dr. Crisp (503), Dunell (509), Emery and Son (512), Fleming and Co. (517), Gaskell, Deacon, and Co. (520), Grimwade and Co. (523), G. Hallett and Co. (525), Hare and Co. (526), Johnson and Sons (542), R. Johnston (543), Langley (554), Mockford and Co. (569), Newman (573), Pegg, Harper and Co. (580), Reeves and Sons (586), Roberts, Dale, and Co. (588), Rose (590), Rowney and Co. (591), T. W. Smith (603), S. & W. Tudor (612), Versmann (613), Wilkinson, Heywoods, and Clark, (623), Wilson and Fletcher (625), Winsor and Newton (627), J. W. Young (633).

ULTRAMARINE.—This lovely pigment, which is one of the most durable used by artists, is prepared by calcining the *lapis lazuli*, a precious stone occurring native in Siberia, Persia, China, and California. The powdered mass is then mixed with resin, wax, and oil. This is placed in water and well kneaded. MM. Clement and Desormes, who were the first to discover the true nature of this pigment, think that the soda contained in the lazulite, uniting with the oil and the resin, forms a species of soap, which serves to wash out the colouring matter. If it should not separate readily, water heated to about 150° Fahr. should be had recourse to. When the water is sufficiently charged with blue colour, it is poured off and replaced by fresh water; and the kneading and change of water are repeated till the whole of the colour is extracted. Others knead the mixed resinous mass under a slender stream of water which runs off with the colour into a large earthen pan. The first waters afford, by rest, a deposit of the finest ultramarine; the second a somewhat inferior article, and so on. Each must be washed afterwards with several more waters before they acquire the highest quality of tone; then dried separately, and freed from any adhering particles of the pitchy compound by digestion in alcohol. The specimens in Messrs. Winsor and Newton's collection are the finest ever exhibited in this country, and are worth more than a thousand pounds.

Artificial Ultramarine.—Real ultramarine, being so extremely dear, it has been in a great measure superseded by the artificial pigment, which is now manufactured in large quantities in Germany and France, by calcining together certain proportions of fine China clay, sulphate of soda, carbonate of soda, sulphur, and charcoal. By varying the proportion of sulphur, tints of different gradations are obtained, from a pure cold blue to a rosy violet. The quality of artificial ultramarine depends greatly on the kind of clay employed; the manufacture has not made much progress in England. Messrs. Gaskell and Deacon exhibit good specimens of this pigment.

The price of the native ultramarine was formerly as high as five guineas the ounce. Since the mode of making ultramarine artificially has been discovered, its price has fallen to a few shillings the pound, and even to a little more than one shilling wholesale. It would appear that in all respects the artificial is equal to the natural product. The chief French manufactories of ultramarine are situated in Paris; the two largest ones in Germany are those of Meissen in Saxony and of Nuremberg in Franconia. Two kinds of ultramarine occur in commerce, the blue and the green, which are true ultramarines;—that is, sulphur compounds.

Sundry Colours.—Other blues of a very fine character are exhibited. *Prussian, chemical, Chinese, and pure blues*, are made by mixing solutions of prussiate of potash, and sulphate of iron, of different strengths. *Cobalt blue*, prepared from smalts, an artificial pigment so called, is a double phosphate of iron and alumina, and approaches ultramarine in beauty of colour. *Chrome Yellow* is made from bichromate of potash and a soluble salt of lead. By combining it with Prussian blue, Brunswick green is obtained. The different ochres and umbers are fine clays, with a varying proportion of oxide of iron. *Vermilion* is a sulphide of mercury. Very fine specimens of cinnabar—native vermilion, from California—will be found at the entrance to the Annex. The *lakes* are precipitated from solutions of madder, cochineal, and Brazil wood, by means of alum. Some specimens of aniline colours, as *lakes*, are also exhibited. These lakes are manufactured from the dyes produced by aniline, and are of wonderful brilliancy. The object in this invention appears to have been to render these colours, hitherto solely produced for the use of the dyer and calico printer, available as pigments. This is accomplished by precipitating the colouring matter from its solution by means of a mixture of starch and alumina, whereby the colour is preserved in its original beauty, and reduced to a condition adapted for paper-staining, artistic, and other purposes.

WHITES—LEAD, ZINC, &c.—The most important of these pigments is white lead, which is a carbonate of that metal; *zinc white* is oxide of zinc, but is much inferior to white lead in its covering power.

S. and W. Tudor exhibit a series of good examples of the corrosions of lead.

REFINED LEADS.—WHITE, RED, AND ORANGE LEAD AND LITHARGE.—For the purposes of making white lead and glass-makers' red lead, extreme purity of the metal is required. Mr. W. Baker has discovered a process by which the ordinary common hard slag lead may be converted into the very best quality. Slag lead which has been smelted in a blast furnace contains sulphur, antimony, copper, iron, amongst other impurities which communicate a hardness that unfits it for the purposes of the arts. The processes for refining it are as follows. Slag lead is treated with nitrate of soda, by which means all impurities are oxidised except copper. The same effect is accomplished by calcining the lead in an improving furnace, especially when the lead contains much antimony. The copper is next removed by a process not yet published, and finally the lead is crystallized by Pattinson's process. The resulting metal is remarkable for its fine crystalline surface, and bold columnar fracture. When it is stated that lead containing only 2¼ oz. of copper per ton communicates a pink tint to the corrosions of white lead, the importance of removing every trace of this impurity is manifest.

Constant white is calcined sulphate of baryta.

ANTIMONY AND ITS OXIDES.—Hallett and Co. are exhibitors of antimony in several states; and in their case will be found a new antimonial white, which they have patented in conjunction with Dr. Stenhouse. This pigment is stated to possess many advantages over the lead and zinc whites.

At page 78, Part I., will be found a description of the ordinary manufacture of white lead. Since that was written, Mr. Baker has introduced examples of fine lead, made for the purposes of the white lead manufacture from slag lead. This is important.

Antimony, a metal of white, silvery lustre, crystalline and brittle; unimpaired by exposure to the atmosphere at ordinary temperatures, but readily oxidised when heated; it is principally used for hardening other metals, viz., with lead and tin for printing types; with tin and copper for Britannia metal; with tin for machinery bearings, instead of gun-metal; and also in medicine in various forms of preparation: its oxides have been lately used as paints, for which patents have been taken, whereby stone-coloured paint is prepared from the native oxide, and white paint from its most abundant one, viz., the sulphide or sulphuret. The superior qualities of these in resisting the action of sulphuretted hydrogen and other destructive gases, and steam; their peculiar adaptability for coating iron, to which they adhere more firmly and toughly than any hitherto known paint; their not being injurious to the workman either in preparation or use; their being equal in body to white lead, though of a specific gravity so much less as to render them from 25 to 30 per cent. less costly in use, will it is expected procure for them a very extended adoption.

The sulphide is found more or less in most parts of the world, chiefly in districts bearing evidence of volcanic origin; the present supplies are drawn principally from Borneo, Hungary, Spain, Portugal, France, Algeria, and various parts of the Mediterranean: lately also it has been found largely in Australia, in gold-bearing quartz, and elsewhere, but heavy land carriage there has hitherto operated against its large importation. The oxide is generally more or less associated with the sulphide.

The metal is prepared chiefly from the native sulphide by fusion with iron, and its after fusion with suitable alkaline fluxes, and cast into bowls or plates possessing a beautiful crystallized, white, metallic surface, resembling the fern-leaf in figure.

OXICHLORIDE OF LEAD.

Exhibitor.—I. L. Bell (473).

A white pigment, patented by the late Hugh Lee Pattinson of Newcastle. It is prepared by precipitating a solution of chloride of lead in hot water with pure lime water, in equal measures; the mixture being made with agitation. The chloride of lead is prepared by treated lead ores (the sulphide of lead—galena) with hydrochloric acid. As the operation of mixing the lime water, and the solution of chloride of lead, requires to be performed in an instantaneous manner, they employ for this purpose two tumbling boxes of about 16 feet cubic capacity, which are charged with the two liquids, and simultaneously upset into a cistern, and from which the mixture flows into other cisterns, where the oxichloride subsides. The formation of the oxichloride takes place while the liquid is flowing in a very thin sheet, being acted on by the air.

This white pigment consists of one atom of chloride of lead and one atom of oxide of lead, with or without an atom of water.

BLACK PIGMENTS.

Blacks are principally the soots of naphtha, naphthaline, resin, or some other cheap inflammable substances giving out large quantities of smoke. *Ivory* and *bone blacks* are the calcined material from which they derive their names, washed with weak hydrochloric acid to remove the mineral matter.

TUNGSTEN COLOURS.

Some remarkable colours prepared from tungsten are exhibited by Mr. Versmann (614). The yellow is tungstic acid; the blue, tungstic oxide; the brown, tungstate of soda and tungsten; and the purple, tungstate of potash and tungsten. See Class I., Oxland (258), page 70.

The porcelain colours exhibited by Bailey (464), and Emery (512), consist of a lead and borax base, coloured with various metallic oxides.

VARNISHES.

Exhibitors.—**Blundell, Spence and Co. (478), Dr. Cattell (494), Mander, Brothers (562), Naylor (572), Rea (584), Vincent (614), Wallis, Brothers (616), Wilkinson and Co. (623), Wilshere and Rabbeth (624).**

Varnishes are of two kinds—*oil* and *spirit varnish.* The former is made by dissolving a gum resin in linseed or other oil, and thinning down the solution with oil of turpentine. A small portion of litharge is generally added, which by oxidising the oil, gives the varnish drying properties. The gums used are *copal*, *anime*, and *cowrie*, and occasionally *amber*. The linseed oil best suited for the purpose is that imported from the shores of the Black and Baltic Seas. *Spirit varnishes* are made by dissolving *shellac*, *sandarac*, *juniper*, *dammar*, *mastic*, &c., in alcohol or methylated spirit. By substituting for the resin *asphaltum* or *pitch*, japan or black varnish is formed.

SUB-CLASS B.—MEDICAL AND PHARMACEUTICAL PRODUCTS.

Exhibitors.—**Howards and Sons (532), Allen and Hanburys (644), J. Bass (645), W. Bastick (646), T. B. Brown (647), Bullock and Reynolds (648), Curtis and Co. (649), Darby and Gosden (650), J. Denoual (651), W. Dickinson (652), Duncan, Flockhart, and Co. (653), J. Gardner (654), W. Holland (655), W. Hooper (656), Lamacraft and Co. (657), W. H. Laurence, (658), Le Maout (659), J. F. Macfarlan & Co. (660), J. Major (661), G. D. Moffatt (662), Sir J. Murray (663), Pharmaceutical Society of Great Britain (664), W. Ransom (665), P. Squire (666), J. Tustian (667), R. Usher (668), R. Waters (669), J. Watts and Co. (670).**

This classification is an exceedingly injudicious one, and it is only retained in this work, that any disagreement with the Catalogue might be avoided. Soda, ammonia, magnesia, salts of the metals, acids, &c., &c., spread over Section A. of this class, are as perfectly pharmaceutical as any of the drugs included in this section.

The majority of these preparations are only interesting to the professional pharmacist. It will therefore be unnecessary to do more than point out a few of the more prominent collections. First in point of extent and importance comes the very complete collection made by the Pharmaceutical Society, under the direction of Dr. Redwood. It contains nearly every preparation that will be found in the new edition of the Pharmacopœia, and will afford to foreign pharmacists a very perfect idea of the British medical system.

The collection of cinchona barks, or, as they are commonly called, the Peruvian barks, is one of great interest. A specimen of each kind of Peruvian bark imported into this country is placed in front of excellent drawings of the cinchona plant, from which it has been divided; and near them, in a case, will be found some growing plants. No other firm but the well-known one exhibiting could have produced this very instructive collection. The case of Messrs. Howards will be found to contain a fine series of quinines and other cinchona alkaloids.

The precise period and manner of the discovery of the therapeutic power of cinchona are enveloped in mystery. Some writers (*e. g.* Geoffroy, Ruiz, and Joseph de Jussieu) believe that the Indians were acquainted with it long before the arrival of the Spaniards; whereas others (*e. g.* Ulloa and Humboldt) are of opinion that the natives were ignorant of the medicinal qualities of the bark until the Spaniards discovered them.

The traditions of the mode of discovery of the remedial power are of a very fabulous character. One, told by Geoffroy, is, that an Indian was cured of an ague by drinking at a pool into which some cinchona trees had fallen. Another, related by Condamine, is, that the Indians observed that the American lions, when ill with ague, eat the cinchona bark! A third, mentioned by Humboldt, and considered to be less improbable, is, that the Jesuits accidentally discovered the bitterness of the bark, and tried an infusion of it in tertian ague.

The period when bark was first introduced into Europe is usually stated to be 1640; but Sebastian Badus gives an extract from a letter of a Spanish physician, D. Joseph Villerobel, from which it appears that it was imported into Spain in 1632, though no trial was made of it until 1639.

The statement of Condamine, that the Countess of Chinchon, wife of the Viceroy of Peru, brought some bark to Europe on her return from South America, in 1639, is not improbable; and from this circumstance it acquired the names of the *Cinchona bark* and the *Countess's powder* (*Pulvis Comitissæ*). About ten years afterwards it was carried by the Jesuits to Rome, and by them distributed among the members of the order, by whom it was taken to their respective stations, and used with great success in agues. Among those most active in promoting its employment was Cardinal de Lugo.

In this way it acquired the names of *Jesuit's Bark*, *Pulvis Patrum*, *Jesuit's Powder* (*Pulvis Jesuiticus*), *Pulvis Cardinalis de Lugo*, &c. It fell, however, into disuse, but was again brought into vogue, in France, by Sir Robert Talbor, who acquired great reputation for the cure of intermittents by a secret remedy. Louis XIV. purchased his secret (which proved to be cinchona), and made it public. Hence it became known in France as *Talbor's Powder*, or the *English Remedy.*

ETHER.

Exhibitors.—**Duncan, Flockhart, and Co. (653).**

Ether, which until within the last ten years was only used in pharmacy, has received an important application in the manufacture of collodion. It is made from alcohol by the action of sulphuric acid, which abstracts from it an equivalent of each of the elements of water.

Ether is often stated to be *dehydrated alcohol.* All reliable evidence is against this view. By the mere abstraction of water, ether is not formed. By the action of sulphuric acid, as a dehydrating agent, ether is not formed, nor is it produced without the agency of heat, consequently it must be regarded as a rearrangement of the elements of alcohol.

Collodion has been referred to. This peculiar preparation is formed by dissolving gun-cotton in ether, and it is now very largely used as the film for receiving the photographic image.

CHLOROFORM.—This anæsthetic agent has been prepared for many years in great purity by this firm. It is in strict chemical language a *Terchloride of Formyle*, a compound of carbon, hydrogen, and chlorine. Dr. Thomson informs us that the best process for obtaining chloroform is to distil with a gentle heat, in a half-gallon retort, 8 ounces of bleaching powder (chloride of lime), 24 ounces of water, and 1½ ounce of alcohol (Sp. g. ·840). The first products are impure, but by washing and redistillation this peculiar fluid is rendered pure.

ESSENTIAL OILS are exhibited by Mr. Holland and Mr. Ransom. Both of these exhibitors cultivate the plants from which they themselves distil the oils exhibited. The reader is referred forward to the section in which Perfumery is described, for an account of processes other than those of distillation by which flower essences are obtained.

The opium alkaloids are well represented by Smith and Sons (604), and Macfarlan and Co. (659). The latter exhibit one of the finest specimens of codeine ever seen crystallized in large masses.

The other articles which will be found within this section scarcely require description in a work of so essentially a popular character as this Handbook.

COD-LIVER OIL, &c.

Messrs. Savory and Moore are large exhibitors of pharmaceutical preparations, amongst others of cod-liver oil.

The two foreign specimens of this oil exhibited are average samples of the article as imported from Norway and Newfoundland. The third sample is oil prepared during the colder months of last winter from fresh cod livers obtained in London. This oil does not differ in its chemical constituents from the foreign products, but is far superior in quality. The colouring matter of the darker oils imported into this country is extraneous to the oil itself, and is produced either by the use of inferior livers, by careless manufacture, or by the employment of too high a temperature during the process of extraction. The slightest approach to putrefaction of the liver itself imparts more or less colour to the oil, accompanied by a disagreeable taste and smell; on the other hand, the fresher the livers, the lower the temperature necessary to extract the oil, the greater the freedom from taste and odour. When obtained from recent livers, by the careful employment of a gentle heat, a pure pale-coloured oil is procured, which, whilst it retains all the active ingredients, is free from nauseating effects of the ordinary commercial varieties.

In addition, Savory and Moore exhibit Dugong oil, obtained from a cetaceous warm-blooded mammal, caught in large numbers on the shores of Ceylon and Australia, in which colonies it is used as a substitute for cod-liver oil. Dugong oil is solid at an ordinary temperature, and has a peculiar fishy taste and smell; its chemical properties are not identical with those of cod-liver and other fish oils, but coincide more with those of ordinary grease. Although highly spoken of in Australia, it is comparatively unknown in this country.

Syrup of Iodide of Iron, &c.—The syrups exhibited are very elegant preparations, some of them being of recent introduction. The compound syrup of phosphate of iron is a preparation from an American formula, and is sometimes designated as "chemical food;" it contains phosphates of iron, lime, and soda, is coloured with cochineal, and flavoured with orange flower.

Fluid Extracts of Opium, Sarsaparilla, Taraxacum, &c.—The alcohol usually employed in the preparation of fluid extracts is in many cases a very objectionable adjunct, imparting to the medicine stimulating properties and a peculiar taste.

Glycerine is an exceedingly good solvent for many of the alkaloids and other vegetable principles, and the fluid extracts prepared with it are superior to those made with alcohol on account of their remaining unchanged for a long period, and being perfectly miscible with water. The extracts contain about 15 per cent. of glycerine.

Pepsine Wine is a preparation having similar qualities to the powdered pepsine, but with the great advantage of being more easily administered—a table-spoonful being equivalent to 15 grains of Boudault's pepsine.

Santonin, the active principle of worm-seed, has acquired a reputation as an anthelmintic. Kamala is also used as a vermifuge. It is administered in doses of from one to three drachms in water.

Anarcotin is an alkaloid contained in opium, possessing, however, no narcotic properties. It has recently been used in India in the place of quinine, for which, should it be required in quantity, it would be a cheap substitute. It has been tested in this country, and has been found an efficient febrifuge.

Datura Tatula is introduced as a remedy in alleviating asthmatic complaints; it is considered superior to the common stramonium, and is employed in the same manner, as shown by the cigarettes and chopped stalks for smoking, exhibited with this sample.

MISCELLANEOUS CHEMICAL MANUFACTURES.

Lucifer Matches.

Exhibitors.—Bell and Black (472), Bryant and May (488), Hynam (538), Klaber (550), Letchford (556).

Ordinary lucifer matches are made by immersing the tops of thin slips of pine in melted sulphur, and when cool, in a mixture of gum, phosphorus, chlorate of potash, and Prussian blue, red lead, or some other colouring matter. By substituting nitre for the chlorate of potash, the detonation and liability to eject sparks are much decreased.

The manufacture of matches from the amorphous phosphorus of Schroetter has only just been introduced into England, although it has assumed great importance for many years past, both in France and Germany. In the safety-matches made by Messrs. Bryant and May, the match-tip contains chlorate of potash, and the friction-tablet on the box, amorphous phosphorus; and it is not until the two are rubbed together that combustion can take place, the two bodies when separate being incapable of becoming inflamed by mere friction. The peculiarity of these matches, therefore, consists in the separation of the two materials which by friction cause combustion. Amorphous phosphorus is only inflammable when rubbed in contact with chlorate of potash or black oxide of manganese. The great advantage of the matches prepared by Bryant and May is, that they will not ignite by any ordinary friction, consequently no danger can arise from their being thrown about by servants, as they often, carelessly, are.

BLACKING.

Exhibitors.—E. Baker and Sons (466), Betts (475), Davis (504), Day and Martin (506 a), Evans (514), Everett (515), Fenn (516), Giles and Barringer (521), Greatorex (522), Mason (564).

This useful substance is made by incorporating bone black with sperm oil, and adding to the mixture a certain amount of molasses or sugar, vinegar, and vitriol. The home and export trade in blacking is at present very large, the well-known firm of Day and Martin sending out no less than 1000 dozen bottles per day.

STARCH.

Exhibitors.—S. Berger and Co. (474), Broomhall (487), J. and J. Colman (499), Doubleday (508), Giles and Barringer (521), James (539), O. Jones and Co. (545), Paling (575), Parsons and Fletcher (576), Reckitt and Sons (585), Springfield Starch Co. (606), Stiff and Fry (609), T. L. Smith (602), Versmaun (614), Wotherspoon (630).

Starch, which is one of the principal constituents of the cereals, is prepared by separating the gluten and other impurities from the powdered or macerated grain, by means of caustic potash, carbonate of soda, or dilute hydrochloric acid. Examined by the microscope, it appears to consist of small globular or egg-shaped sacs, which when acted on by hot water break and emit a substance soluble in water. *Dextrine.*—Torrified starch or dextrine is starch submitted to the action of dry heat until the granules burst, hence its solubility in cold water. It is also called British gum. Starch, prepared with tungstate of soda (Versmann, 614), is exhibited under the title of the Ladies' Life Preserver, from the tungstate of soda contained in it rendering fabrics stiffened with it perfectly non-inflammable.

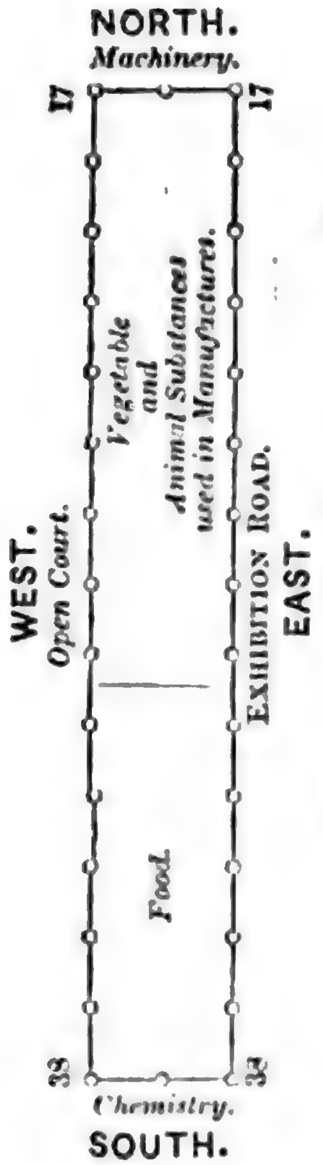
GRAPHITE. *Plumbago.*

Exhibitor.—B. C. Brodie (486).

Mr. Brodie purifies plumbago by mixing it in coarse powder, in an iron vessel, with twice its own weight of commercial sulphuric acid, and seven per cent. of chlorate of potash, and heating the whole over a water bath until chloric oxide ceases to be evolved. By this means the compounds of iron, lime, and alumina present are rendered for the most part soluble, and the subsequent addition of a little fluoride of sodium to the acid mixture will decompose any silicates which may remain, and volatilise the silica present. The mass is now washed with abundance of water, dried, and heated to redness. This last operation causes the grains of the plumbago to exfoliate. The mass swells up in a surprising manner, and is reduced to a state of very minute division. It is then levigated, and obtained in a state of great purity, ready to be compressed by the method of Brockedon, for the manufacture of pencils.

CLASS III.—SUBSTANCES USED AS FOOD.

Number of Exhibitors, 154.



SITUATION OF CLASS.—*Eastern side of Eastern Annex.*

For convenience this Class is divided into three Sections.

a. AGRICULTURAL PRODUCE.
b. DRYSALTERY AND GROCERY.
c. WINE, BEER, SPIRITS, AND TOBACCO.

These are grouped together in the Class; as Classes III. and IV. have much in common, they are placed together in the plan.

AGRICULTURAL PRODUCE.

WHEAT AND OTHER CEREALS, MALT, &c.

Exhibitors.—Adkins (700), Asprey (701), Brown and Polson (704), Cahill (706), Chambers (708), Chitty (709), Christie (710), Fordham (712), Fuller (713), Hallett (714), Irwin (716), Kirk and Swales (717), MacKean (720), Polson (724), Raynbird (725), Robinson, Bellville, and Co. (726), Stevens (728), Strange (729), Styles (730), Taunton (732), Taylor (733), Webb (735), Wellsman (726), Wrench (738).

The ordinary English wheats are varieties of the *Triticum vulgare*, the main differences between them being in the size and colour of the grain, its softness or hardness. Each variety requires close attention to the soil necessary for its proper culture, and the time at which it is most advisable to sow the seed. The finest English wheats are *Tulavera*, which produces excellent crops upon gravelly soil; *Chidham*, a round, white, oven-grained wheat, suitable for rich-bearing soils; *White Turnip*, which is mostly sown in the southern counties, and *Red Nursery*, a red wheat with white chaff, much sown in limestone or chalky districts. In Case 714, is a remarkable specimen of wheat, the ears of which are of enormous size. This wheat has been literally *bred* by selection; a certain quantity of the best Red Nursery wheat was sown, and on the corn ripening, the seed from the largest ears only was selected and sown for the following year; when fully grown the seed from the largest ear of the second year's growth was again selected and sown, and the process of selection repeated until the present result was obtained. By this means not only is the number of grains in each ear increased, but also the number of ears belonging to each plant. Barley is used principally for malting, and as food for cattle. In Scotland it is much employed as human food in the form of Scotch or pearl barley, which is the grain denuded of its husk, and rounded by a certain process. Oats are used as oatmeal and groats, the former being more or less roughly ground, and the latter, the crushed or bruised grain. Rye, which is extensively used for making bread by the poorer inhabitants of continental Europe, presents but few points of interest in this country. A very fine specimen of "Gruaux" flour is exhibited in Case 709. By careful grinding and repeated sifting through silk sieves, a quality is obtained which exceeds all others for fineness and whiteness. Many of the examples of flour shown are of excellent quality.

MALT,

Which is, it need scarcely be said, barley which has undergone, on the malting floor, the process of germination, by which the starch of the grain is converted into sugar, is exhibited of fine quality. A quantity of good barley which weighs 100 lbs. being judiciously malted, will weigh, after drying and sifting, 80 lbs. Since the raw grain, dried by itself at the same temperature as the malt, would lose 12 per cent. of its weight in water, the malt process dissipates out of these remaining 88 lbs., only 8 lbs., or 8 per cent. of the raw barley. This loss consists of—

1½ per cent. dissolved out in the steep water,
3 „ dissipated in the kiln,
3 „ by the removal of the fibrils,
0½ „ of waste.

The bulk of good malt exceeds that of the barley from which it was made, by about 8 or 9 per cent.

The quantity of malt upon which duty is paid annually, amounts to 36,000,000 bushels.

HOPS.

Exhibitors.—**Bakers, White, and Morgan (702), Kitchin (718), Pack (721), Paine (722), Woolloton and Sons (737).**

These important products next merit our attention. In England hops are grown principally in the counties of Kent, Sussex, Surrey, Hampshire, Worcestershire, and Herefordshire, the soil and climate of each district modifying the taste, smell, colour, and size of each crop. The principal varieties are known as "Grapes," "Jones's," "Colgates," "Goldings," and "White Berries." The finest of these are "Goldings," grown chiefly in middle and East Kent; "Colgates" are valued for their strong and somewhat coarse flavour. Hops grown in the Farnham district are much used in the west of England for making old ales. On the Continent, Bavaria, Belgium, Bohemia, France, Wurtemberg, Poland, and Russia, are the principal hop-growing countries, the quality being in the order of their names. Two very instructive series of British and foreign hops are shown by Baker & Co., and Woolloton & Sons. In the latter case two sections of the pocket are shown, accompanied by the name of the locality, variety, and grower, in addition to which a description of the soil is given, an important item in considering the merits of any kind of agricultural produce.

GRASSES, &c.

Exhibitors.—**Butler and McCulloch (705), Carter and Co. (707), Sutton and Sons (731), J. Wright and Son (739).**

The collections of grasses shown by each of these exhibitors are of considerable interest.

Sutton and Sons exhibit one hundred grass seeds, and good examples of each of these grasses. The following hints on sowing grass seeds for permanent pasture may be of interest to many:—

It is highly important that the land should be cleared from weeds, and well pulverized before the seed is sown; and in all cases where the soil is loose or sandy, it is desirable that it should be rolled before sowing.

If this is not effected, the seeds (many of which are very minute) will some of them be too deeply imbedded in the soil, while others may not be covered at all.

It is also desirable that the seeds should be sown when there is not much wind, and that they should be delivered from the machine, or the hand, placed rather near to the soil, otherwise the smallest and most valuable of the seeds may be carried by the wind into the adjoining field or hedgerow.

The harrows (which should be very light, bush harrows are suitable), must be again drawn over after sowing, and if the soil is light and dry, the roller also.

If the soil is poor, a dressing of Peruvian guano or superphosphate may be harrowed in, at the rate of 2 cwt. per acre.

If corn is sown with the grass seeds, it should not be more than 1 or 1½ bushel of oats or barley (and the former are preferable) to the acre.

March, April, and May, are the best months for sowing grass seeds; September is also a suitable season, but the *earlier* in that month the better.

The best manner of sowing is with a seed barrow; or for two men, one with the large seed, and the other following him with the small seed, to sow them broadcast.

In the same collection are clusters of the seeds of Lula Kafir, "Impheé," or *Holcus Saccharatus*, and a good series of Conifera, many of them rare.

Food for cattle, and compressed hay, appear to complete this section.

DRYSALTERY, GROCERY, &c.

TEA.

Exhibitors.—Dakin and Co. (770), Phillips and Co. (818).

Tea is the dried and rolled leaves of different varieties of certain shrubs indigenous to China, Java, Japan, and Assam, known to botanists as the *Thea Bohea* and *Thea viridis.* These plants are propagated by seed, the seedlings being planted in rows when a year old. They reach a height of from three to six feet, yielding three or four crops of leaves every year for ten or twelve years. The first gatherings of the season are the most valuable. From these is prepared Pekoe tea, which consists of the young leaf buds of the plant, the second gathering yielding black teas of the finest quality, the remaining two being comparatively inferior. A remarkable specimen of Flowery Pekoe, showing the long downy miniature leaf buds, is exhibited by Messrs. Dakin. The chief varieties of black tea are Bohea, Congou, Souchong, Caper, Pekoe, the blackness being due to a slight fermentation undergone before their second roasting. The principal varieties of green tea are Twankay, Hyson, Imperial, and Gunpowder. Green tea is only roasted once, and hence it preserves its natural colour. The green tea of China is coloured with Prussian-blue and clay to give it the bright green tint, supposed to be preferred by the English "barbarians." The natural colour of green tea may be seen in the samples from Java and Japan, shown by Messrs. Phillips. (See the remarks on Theine in Chemical Class, page 116.)

COFFEE.

Exhibitors.—Phillips and Co. (818), Stanes (827), Clerihew (762).

Some interesting specimens of the pod of the coffee plant, preserved in spirit, showing the way in which the so-called berries lie packed together, is exhibited by Mr. Stanes. Specimens of the flowering plant and of the berry, before and after the husk has been taken off, are also shown, accompanied by some excellent photographs of coffee plantations, and a drawing of process for curing coffee.

CHOCOLATE AND COCOA.

Exhibitors. — Cadbury Brothers (760), Collier and Son, (765), E. Dorguin (774), Dunn and Hewett (776), Du Parcq (777), Farmer and Co. (781), Fry and Sons (783), Lebaigue (798), Myzoule (815), Fletcher, Parsons, and Co. (815), Phillips and Co. (818).

Cocoa is prepared from the seeds of the *Theobroma Cacao*, a small but handsome tree, growing spontaneously in the West Indies, Mexico, Caraccas, and Demerara. The seeds are enclosed in a pod closely resembling a small stout cucumber. When they arrive at a state of maturity, the pods are gathered opened and the seeds are cleared of the pulp adhering to them. Before being dressed they are subjected to a slight fermentation in covered tubs or trenches, a process which greatly improves their flavour. The finest cocoas are those of Caraccas, Trinidad, and Central America, the produce of the West Indies being smaller and more bitter in taste. When roasted, ground, and reduced to paste, they form what is commonly known as flake cocoa, which is the purest form. The ordinary soluble cocoa of the shops contains larger or smaller quantities of starch or arrowroot, according to the honesty of the manufacturer.

Chocolate should properly contain no other ingredient but the best cocoa—ground without the husk—sugar, and some flavouring essence, such as vanilla, cinnamon, or musk. The French and Spaniards generally excel in this manufacture; there are, however, several specimens in the British division which will bear favourable comparison with those shown by our foreign neighbours. English chocolate is often gritty and bitter; this arises from the sugar not being properly diffused through the mass, or from the husk of the cocoa being ground up with the paste.

Fry and Sons, of Bristol, have a complete series illustrating the manufacture of chocolate and cocoa. It includes botanical illustrations; including branch, leaves, and fruit of the *Theobroma Cacao*, or cocoa tree—one of the pods opened, showing the seed or cocoa of commerce; specimens of raw cocoa imported from various countries; specimens illustrating the various stages of manufacture; including the nibs, or crushed kernel, the shell or husk, the oil extracted, or cocoa butter, chocolate in cakes, chocolate rendered soluble in boiling water; samples of vanilla used in flavouring; Iceland moss, and other illustrated articles. Various samples of manufactured chocolate and cocoa are sold to the public.

For many years previous to 1832, the quantity of cocoa consumed in England did not much exceed 300,000*l.* per annum: it has now reached above 3,000,000*l.* per annum. There is no doubt that the chief circumstance which has tended to check this increase, has been the continual desire for a cheap article; to gratify which, some manufacturers have inflicted upon the public an inferior quality, thus producing an unjust prejudice against all kinds of chocolate and cocoa. Against this description of competition the public cannot be too much on their guard.

The relation of tea and coffee to each of these has been already noticed. The following analyses by Liebig will show how completely the cocoa belongs to the nitrogenized vegetable products.

	Caffeine, the principle of Coffee.	Theine, the principle of Tea.	Theobromine the principle of Cocoa and Chocolate.
Carbon - -	49·77	50·101	47·21
Hydrogen -	5·33	5·214	4·53
Nitrogen -	28·78	29·009	35·38
Oxygen - -	16·12	15·676	12·88
	100	100	100

There are many examples of the use of cocoa as confectionery.

CHICORY.

Exhibitors.—Collier and Sons (765), R. and J. Harrison (786), Fry and Sons (783).

Chicory root—the root of the *Cichorium intybus*, Wild Succory or Chicory—roasted, has been employed as a substitute for coffee for more than eighty years. It is now employed extensively as a mixture with coffee, which, although allowed, cannot be regarded other than an adulteration.

Chicory root is heated in iron cylinders, which are kept revolving as in the roasting of coffee. In this country about two pounds of lard are added to every cwt. of chicory during the roasting process: in France butter is used; by this a lustre and colour resembling that of coffee is imparted to it. When roasted the chicory is ground to powder and mixed with the coffee. Chicory has been supposed by some persons to be wholesome and nutritive, while others contend that it is neither one nor the other; however, no obvious ill effects have been observed to arise from its employment, if we except the occasional tendency to excite diarrhœa when it has been used to excess. The analysis of chicory root by John gave 25 parts *watery bitter extractive*, 3 parts *resin*, besides *sugar*, *sal ammoniac*, and *woody fibre*.

PRESERVED MILK.

Exhibitors—V. B. Fadeuilhe (779), Moore and Co. (811).

This substance, so useful to travellers, is prepared by evaporating perfectly fresh milk over a gentle fire, and preserving the dried residue in hermetically sealed bottles.

SUGAR.

Exhibitors—J. Beattie (755), Clyde Sugar Refiners' Association (763), Martineau and Sons (810).

The chief part of the sugar used in England is obtained from the *Saccharum officinale*, or sugar-cane, of which there are several varieties. The canes are cut down and the leaves and tops cut off; they are then crushed between grooved rollers, which squeeze out the juice. The juice is clarified by means of quicklime, strained and reduced by evaporation to a thick syrup, when the whole is cooled and granulated in shallow pans. The uncrystallizable portion, or treacle, is strained from the crystals which now form the raw or brown sugar of commerce. Raw sugar, as imported from the West Indies, generally requires refining before it is sold to the consumer. This is effected by heating together three parts of raw sugar dissolved in one part of lime water and mixed with animal charcoal in the form of burnt bones. The heated syrup is filtered and still further clarified by once more filtering it through a bed of animal charcoal. The clear syrup is evaported in a vacuum pan, and when it has reached a certain degree of concentration, it is run into conical moulds to cool. It is further whitened by allowing a solution of colourless syrup to percolate through its mass, in order to remove any coloured syrup that may be mechanically returned by the crystals. The resulting loaves are then dried on a stone, and finished in a lathe for sale. Crystallized sugar is prepared by evaporating the clarified syrup in shallow pans. Some of the samples of crystallized sugar are very fine, the crystals, which are double oblique prisms, being large and perfect. There are samples of sugar from nearly all parts of the world. A large drawing of a sugar refinery will show the progress of this manufacture.

PRESERVED MEATS.

Exhibitors—**Batty and Co. (754), Copeland and Co. (767), Crosse and Blackwell (769), Gamble, Power, and Co. (784), Garrard (785), Jones and Trevithick (795), Liverpool Preserved Provision Co. (800), McCall and Co. (802), Morton (812), Partridge (816).**

The trade in preserved meats has assumed gigantic proportions, many thousand tons being now consumed annually by our navy and army, by travellers, emigrants, and residents in India, and other hot climates. The principle of manufacture is in most cases the same: the material is introduced into a tin vessel, the top being soldered down with the exception of a small hole; the tin is then exposed to heat, and as soon as it is full of steam it is hermetically sealed by a drop of solder being placed on the hole by which the steam escapes.

Messrs. Jones and Trevithick exhibit several specimens of preserved *raw* meat, which is a valuable improvement on the usual process. The meat is introduced into a tin vessel, and the air is exhausted, a small quantity of sulphurous acid gas is then introduced, which is quickly absorbed by the juice of the meat. Nitrogen gas, which is incapable of exerting any putrefactive action on animal substances, is then allowed to enter the vacuum, and the can is sealed. This process has but lately been perfected; and if the results are capable of standing the effects of time it will be a great step in advance, and go far to supersede the present process.

PICKLES AND PRESERVED FRUITS.

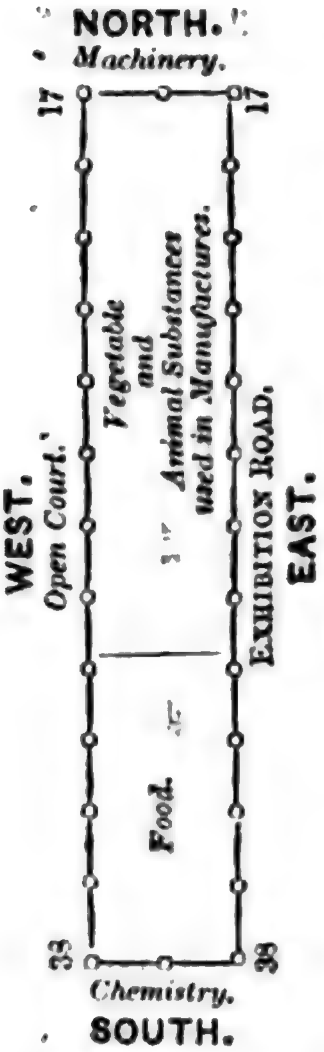
Exhibitors—Barnes, Morgan, and Co. (753), Batty and Co. (754), Cocks (764), Copeland (767), Crosse and Blackwell (769), Duncan (775), Fortnum and Mason (782), Gamble and Power (784), Keiller and Son (796), J. R. Lewis (799), Makepeace (807), Marshall and Son (808), Morton (812), Partridge (816), Smith, Suttie, and Co. (824), Wotherspoon and Co. (837).

A great improvement has been made in the manufacture of pickles and preserves by the discontinuance of the system of brightening the natural yellowish green colour of the preserved vegetable by means of copper. In preserved fruits, the specimens exhibited by Messrs. Fortnum and Mason are especially noteworthy. The collection comprises examples of nearly every known fruit, nut, or seed, which is preserved or dried for eating. The specimens of the different species of almond are very interesting, and many of the fruits from China and South America are unique.

CONFECTIONERY AND WEDDING-CAKES.

Exhibitors—Bexfield and Wood (756), Bolland (757), Dorguin (774), Hill and Jones (791), Keiller (796), Lebaigue (798), Marshall (809), Myzoule (813), Schooling (821), Shackle (823),

CLASS IV.—ANIMAL AND VEGETABLE SUBSTANCES USED IN MANUFACTURES.



Number of Exhibitors, 250.

SITUATION OF CLASS.—*It extends northwards in the Eastern Annex, from the Class devoted to Food, to that which is given to Machinery, embracing the space between Columns* 21 *and* 32.

This Class is divided into four Sub-Classes, as follows:—

OILS, FATS, WAX, AND THEIR PRODUCTS: OTHER ANIMAL SUBSTANCES USED IN MANUFACTURES: VEGETABLE SUBSTANCES USED IN MANUFACTURES: PERFUMERY.

OILS.

Exhibitors.—Brecknell, Turner and Sons (912), Dr. Cattell (914), Langton, Bicknell and Sons (926), G. Neighbour and Sons (935), Price's Patent Candle Co. (939), W. A. Rose (942), J. Sentis (944), J. and W. Marshall (930).

It appears to be scarcely necessary to make any special remarks on the oils exhibited. Oils are divided into fixed or fatty oils, and volatile or essential oils. The members of one class differ greatly, in nearly every respect, from those of the other class. The former are usually bland and mild to the taste; the latter hot and pungent. The term distilled, applied especially to the last class, is not quite correct, since some of them are obtained by expression, as the whole of the first class may be, and commonly are. All the known fatty substances found in organic bodies, without reference to their vegetable or animal origin, are, according to their consistence, arranged under the chemical heads of oils, butters, and tallows. They all possess the same ultimate constituents,—carbon, hydrogen, and generally oxygen, and some few of the essential oils, sulphur also; but, as a class, they are noted for containing a large proportion of carbon, which renders them valuable as food, and as sources of light.

The importance of the whale fishery for the purpose of obtaining sperm oil will be seen from the following statement:—

Going back seven years, we find that the number of vessels was nearly 670; on the 1st of January, 1860, it was only 571, showing a decrease, as compared with the previous year, of 54 vessels, with an aggregate of 18,066 tons; and it is calculated that there will be as great a falling off during the current year. The whole imports of 1859 were as follows:—Sperm, 9,141 tons; whale, 19,041 tons; bone, 1,923,850 lbs. From this it appears that there has been an excess over the year 1858, in sperm, of 946 tons; whale, 819 tons; and in bone, 323,250 lbs. The exports of oil and bone were—sperm, 5,221 tons; whale, 818 tons; and bone, 1,707,929 lbs. This shows that the export of sperm oil in 1859 largely exceeds that of 1858, while that of the whale has been light. As regards prices, the average of whale oil was, in 1858, 2*s.* 3*d.*, and in 1859, 2*s.* 0½*d.* per gallon. During the same periods the prices in this country were respectively 2*s.* 2*d.* and 2*s.* 5*d.* per gallon. In America sperm oil, in 1858, was 5*s.* 5*d.*, and in 1859, 5*s.* 8*d.* per gallon, against 7*s.* to 8*s.* in this country.

SPERMACETI.

Exhibitors—Langton, Bicknell, and Sons (926), C. Ogleby and Co. (956), and exhibitors of candles generally.

Spermaceti is a solid crystalline fat, extracted from the brain of the spermaceti whale, in which it occurs, mixed with a fluid oil (sperm oil). The impure mixture is filtered from the oil and pressed, the last portions of the latter substance being removed by saponification. Sperm candles contain a small proportion of wax, to prevent crystallization. They are sometimes tinted with gamboge, and sold under the name of "transparent or vegetable wax."

The sperm whale, *Physeter macrocephalus*, called also cachalot, is a carnivorous cetacean, living chiefly on cuttle fish, and having its mouth armed with teeth instead of whalebone. It is gregarious, and inhabits the open oceans of both eastern and western hemispheres, ranging between 60° N. L. and 60° S. L.; but abundant, and pursued chiefly in the region of the line-currents, between 7° N. L. and 7° S. L. It grows to a large size, the male to 60 feet in length, the female to half that dimension. The former yields 70 to 90 barrels of sperm-oil, the latter 20 to 30. The spermaceti is contained in cellular cavities, occupying the anterior and upper parts of the unwieldy head: from 200 to 500 gallons of this "head matter" are yielded by a whale. One-sixth of the entire produce is the usual proportion. This matter is placed in hair bags, submitted to strong pressure, melted and boiled with a weak solution of potash and in alcohol, then casts into moulds, when it becomes the crystalline substance called spermaceti, which is itself a peculiar species of stearine. Cetine is its purified state.

The whalebone, or *baleen*, as it has been called, consists of numerous parallel laminæ, descending perpendicularly from the palate of the *Balæna mysticetus.* Its object in the economy of the animal is to form an efficient strainer for its food, which is taken in with the water; and the latter, when the mouth is partially closed, is expelled, leaving the small crustacea, and other animals which constitute the nourishment of the whales, entangled as it were in the laminæ of whalebone. Although all the species of *balæna* possess the substance, it is furnished in the largest quantities, and of the finest quality, by the *Balæna mysticetus*, which is the object of eager and incessant pursuit, not only for the value of this substance, but for the immense supply of oil which is obtained from the thick layer of blubber or cutaneous fat in which the body is enveloped. The length of the largest pieces of baleen in a whale 60 feet long is frequently as much as 12 feet; and the laminæ are ranged in two series, each containing about three hundred in number.

STEARIC ACID AND STEARINE.

Exhibitors.—**J. Sentis (944), W. Taylor and Co. (947), F. Tucker and Co. (949), S. Clarke (915), Brecknell, Turner and Sons (912).**

The solid portions of fats are known by this term, the fluid portions being called *oleine* (from ἔλαιον, oleum, oil). If melted tallow be dissolved in about eight times its weight of ether on cooling the oleine alone remains dissolved, the stearine crystallises, and can be rendered absolutely pure by washing with ether. Stearine is a solid transparent substance, easily reduced to powder. At one time stearine was an object of manufacture; but the production of stearic acid has superseded it. The process employed for the production of stearine was very simple. Tallow was melted, and by being kept quiet in the melted state all impurities subsided and were removed. Then the fluid and transparent tallow was allowed to cool as gradually as possible to the temperature of 100° Fahr. During the process of cooling the fluid mass is kept constantly agitated. At the above temperature, the stearine only becomes solid, separating from the oleine in a crystalline form, thickening the whole into a pasty mass. This is then placed in cloths and subjected to pressure in the hydraulic press. The oleine is absorbed by the cloths, or drains off, and the stearine is eventually obtained in a solid cake, in many respects resembling spermaceti.

Chevreul's discovery of the constitution of fats, led to the present processes for the manufacture of stearic acid. Pure stearic acid is prepared, according to its discoverer, Chevreul, in the following way :—Make a soap by boiling a solution of potash and mutton-suet in the proper equivalent proportions; dissolve one part of that soap in six parts of hot water, then add to the solution forty or fifty parts of cold water, and set the whole in a place whose temperature is about 52° Fahr. A substance falls to the bottom, possessed of pearly lustre, consisting of the bi-stearate and bi-margarate of potash; which is to be drained and washed upon a filter. The filtered liquor is to be evaporated, and mixed with a small quantity of acid necessary to saturate the alkali left free by the precipitation of the above bi-salts. On adding water to it afterwards, the liquor affords a fresh quantity of bi-stearate and bi-margarate. By repeating this operation with precaution, we finally arrive at a point when the solution contains no more of these solid acids, but only the oleic. The precipitated bi-salts are to be washed and dissolved in hot alcohol. During the cooling of the solution, the bi-stearate falls down, while the greater part of the bi-margarate, and the remainder of the oleate, remain dissolved. By repeatedly dissolving in alcohol, and crystallising, the bi-stearate will be obtained alone.

CANDLES.

Exhibitors—**Barclay and Son (910), Bauvens (911), Brecknell, Turner and Sons (912), S. Clarke (915), J. C. and J. Field (918), W. S. Hale and Sons (921), Langton, Bicknell and Sons (926), T. Mitton (934), C. Ogleby and Co. (936), Penfold and Martin (937), Price's Patent Candle Co. (939), Taylor and Co. (947), F. Tucker and Co. (949), West of England Soap Co. (950).**

The principal candles exhibited are those made of stearic acid (or stearine, as it is erroneously called), either pure, or with a mixture of other fatty acids or tallow. In order to explain the mode of manufacture, it will be necessary to go slightly into the chemistry of the subject. Tallow and other fats consist principally of stearic, margaric, and oleic acids united with glycerine. The mixture of these substances melts at a comparatively low temperature, on account of the glycerine and oleic acid being liquids. In order, therefore, to obtain a less fusible compound, it is necessary to employ certain means to remove these two bodies, and leave behind a mixture more or less pure, of stearic and margaric acids. This is effected in two ways—1st, by sulphurous saponification; 2nd, by calcareous saponification.

Calcareous saponification.—This process is mostly followed in France, where it was discovered by De Milly. The tallow is melted by hot steam, and milk of lime is added until an insoluble lime soap is formed, or, in other words, until the glycerine is replaced by lime. The fatty mixture now consists of stearic, margaric, and oleic acids, united with lime in a solid form, and glycerin in a liquid state. By pressure the glycerine is forced out, and the remaining fatty solid is decomposed by sulphuric acid, which unites with the lime and sets free the stearic, margaric, and oleic acids. This mixture is submitted to pressure, and the oleic acid is forced out, leaving behind a compound of stearic and margaric acids, which is fusible only at a temperature of 130° or 140°.

Sulphurous saponification.—In this process, which is the one usually employed in England, the separation of the fatty acids from the glycerine is brought about by sulphuric acid, which combines with the glycerine, forming sulpho-glycerine, and which is soluble in water, and setting free the stearic, margaric, and oleic acids. Subsequent pressure extracts the latter, the solid acids being left behind.

A third process is employed by Price's Patent Candle Company, which consists in injecting superheated steam into the melted fat. A union of glycerine and water takes place, and the fatty acids are set free as in the other processes.

The best stearic candles contain stearic and margaric acids almost in a state of purity, the second and third qualities being softer and more fusible, from containing more or less oleic acid and glycerine. Composite candles are mixtures of stearic acid and stearine. Since the introduction of stearic candles, the more expensive wax candle has been comparatively little used. Some excellent specimens may be seen in Case 949; also several beautiful specimens of very large wax candles, decorated with flowers and Biblical inscriptions, and used in the religious ceremonials of the Roman Catholic Church.

Messrs. Barclay and Son exhibit a good series, illustrative of candle manufacture, including, in addition to wax, spermaceti, stearine, paraffin, &c., vegetable wax candles—which are spermaceti coloured with gamboge—also wax mortars, bougies, &c.

In Case 937 is exhibited a tubular candle, constructed on the Argand principle, containing a ring of wicks. Of course a special candlestick is required for its use.

SOAP.

Exhibitors.—**F. L. Bauwens (911), Brecknell, Turner and Sons (912), E. C. Cook and Co. (916), Cowan and Sons (917), D. and W. Gibbs (919), W. Gossage and Sons (920), J. Knight and Sons (924), W. Mac Kean (928), Robin and Houston (941), T. B. Rowe and Co. (943), J. Sentis (944), W. Taylor and Co. (947), West of England Soap Co. (950), J. Williams and Son (953).**

Soaps made with soda are hard; those made with potash are soft; the degree of hardness being so much greater as the melting-point of the fats employed in their manufacture is higher; hence the more oleine a fatty matter contains, the softer the soap made with it will be, and *vice versâ.* The softest soap, therefore, would be that made altogether with oleine (oleic acid) and potash (oleate of potash); the hardest would be that made with stearine and soda (stearate of soda).

The fats or oils employed for the manufacture of soaps, are tallow, suet, palm oil, cocoa-nut oil, kitchen fat, bone grease, horse oil or fat, lard, butter, train oil, seal oil, and other fish oils, rape oil, poppy oil, linseed and hempseed oil, olive oil, oil of almonds, sesame, and ground nut oil, and *resin.* This last substance, though very soluble in alkaline menstrua, is not, however, susceptible, like fats, of being transformed into an acid, and will not, of course, saponify or form a proper soap by itself. The more caustic the alkali, the less consistence has the resinous compound which is made with it. The employment of caustic alkalies, however, is not necessary with it, since it dissolves readily in aqueous solutions of carbonated alkalies, but even with carbonate of soda it forms only a viscid mass, owing to its great affinity for water, so that even after having been artificially dried in an oven, and thus rendered to a great extent hard, the mass deliquesces again spontaneously by exposure, and returns to the soft state. The drying oils, such as those of linseed and poppy, produce the softest soaps.

We said that by boiling fats or oils with an aqueous solution of potash or of soda, a solution of soap was produced. The object of the soap-maker is to obtain the soap thus produced in a solid form, which is done by boiling the soapy mass so as to evaporate the excess of water to such a point that the soap may separate from the concentrated liquor and float on the surface thereof in a melted state, or by an admixture of common salt, soap being insoluble in lyes of a certain strength or degree of concentration, and in solutions of common salts of a certain strength, the glycerine remaining, of course, in solution in the liquor below the separated soap. Such is the theory of soap-making; but the *modus operandi* followed by practical soap-makers will be described presently.

On the Continent olive oil, mixed with about one-fifth of rape oil, is principally used in making hard soap. This addition of rape oil is always resorted to, because olive oil alone yields a soap so hard and so compact that it dissolves only with difficulty and slowly in water, which is not the case with rape oil and other oils of a similar nature, that is to say, with oils which become thick and viscid by exposure, and which on that account are called drying oils, experience having taught that the oils which dry the soonest by exposure, yield with soda a softer soap than that made with oils which, like olive oil, remain limpid for a long period under the influence of the air. The admixture of rape oil has, therefore, the effect of modifying the degree of hardness of the soap, and, therefore, of promoting its solubility. In England tallow is used instead of olive oil: the soap resulting from its treatment with soda is known under the name of *curd soap*, and is remarkable for the extreme difficulty with which it dissolves in water. The small white cubic, waxy, stubborn masses, which until a few years ago were generally met with on the washing-stand of bed-rooms in hotels, and which for an indefinite period passed on from traveller to traveller, each in turn unsuccessfully attempting, by various devices and cunning immersions in water, to coax it into a lather, is *curd soap*. Rape or linseed oil, added in certain proportions to tallow, would modify this extreme hardness and difficult solubility, but it is now the general practice to qualify the tallow with cocoa-nut oil—an oil, which, converted into soap, has the property of absorbing incredible quantities of water, so that the soap into the manufacture of which it has entered lathers immediately. Cocoa-nut oil, however, acquires by saponification a most disagreeable odour (due to the formation of caprylic acid), which it imparts to all the soaps in the manufacture of which it enters, an odour which exists in spite of any perfume which may be added to mask it.

This is extracted from an excellent article on Soap, by Dr. Normandy, in Ure's *Dictionary of Arts and Manufactures.*

An interesting collection of articles, manufactured by Gossage and Sons, of Warrington, are exhibited.

These consist of compound soap manufactured from ordinary fatty materials, saponified by soda, with which is combined solution of silicate of soda.

Soda-glass, soluble in water, produced by fusing together siliceous sand and carbonate of soda, in the proportion of three equivalents of silica, and two equivalents of soda, and solution of the same.

Potass-glass, soluble in water, produced by fusing together siliceous sand and carbonate of potass, in the proportion of three equivalents of silica, and two equivalents of potass, and solution.

When silica is combined with soda or potass, so as to produce soluble glass, the compound obtained contains alkali in a weak state of combination; and it is in this state analogous to soaps composed of fatty acids and alkali, possessing similar detergent properties. It has therefore been found to be a valuable material for reducing the cost of soap without decreasing its useful properties.

Alkaline silicates are also used largely by calico-printers, and for the purpose of indurating porous stones.

CAMPTICON, OR CONSOLIDATED OIL.

Exhibitors—**Frederick Walton and Co.**

Numberless attempts have been made to produce a material possessing the qualities of india-rubber. It is well known that linseed, nut, and poppy oils possess that nature—which distinguishes them from lubricating oils—of becoming concrete on exposure to the atmosphere; that is, when spread in a thin layer, they dry or change into a thin skin. This change is produced by the absorption of oxygen and the disengagement of carbonic acid, and is, in reality, a change of their elementary constitution.

This property of absorbing oxygen rapidly is not considerable in the crude or raw linseed oil, but it is very greatly increased by boiling the oil—that is, exposing a large quantity of raw oil to a strong heat in a caldron, with a small percentage of oxide of lead added. It is then called "varnish," and has a more viscid character, and is also rather more highly covered. A layer of this oil requires from six to twenty-four hours to dry or change into a skin-like surface, according as the state of the atmosphere is more or less favourable.

By dipping panes of glass into linseed oil, and allowing the films or layers to dry, then repeating the process, the manufacture of india-rubber from the milk is imitated, and we thereby produced a solid elastic substance, composed of many layers of perfectly oxidized oil. Having accumulated a quantity of solid oxidized oil by drying it upon extensive surfaces, such as prepared cloth, stretched in frames, the skin or film is scraped or peeled off by suitable means.

By crushing the solid oxidized oil obtained in sheets as described, and working it thoroughly in hot mixing rolls, there is produce a substance which requires only the cohesive nature, existing so strongly in india-rubber. The addition of a small proportion of shellac gives that; and thus is obtained a material, singularly like caoutchouc when worked into dough, and which can be rolled on to fabrics in the same manner and with the same facility—giving a perfect waterproof cloth, unlike oil-cloth, but having the rubber finish and flexibility. Pigments could easily be added to give colour; the addition of resins give other, or rather varied proportions of adhesion, useful as affording the means of uniting fabrics as by rubber. Fibre, whether flock or cork, mixed in and rolled into sheets, gives samples of kamptulicon and other floor-cloths.

This curious and useful substance has peculiar properties. Obtained from oil it is unaffected by oil. For a long time the discoverer was baffled in every attempt to find a solvent. Any heat short of carbonising it had no effect on the material, and here was evident a great advantage over rubber for practical purposes, if other desiderata were accomplished. At length this converted oil was dissolved in alcohol and wood spirit, thus forming a varnish.

Not only has this singular product been thus assimilated to rubber for uses on fabrics, or combined with fibre for floor-cloths, but, still more strange, it is capable of being worked with pigment and vulcanized exactly as india-rubber has been described to be, forming a hard compound like vulcanite and ebonite, excepting that the sulphur is not necessary.

LIST OF APPLICATIONS.

Surface Fabrics.—Clothing, carriage aprons, cart sheets, sail covers, bath sheets, &c.

Imitation Leathers.—Carriage lining, chair covers, boot and shoe leathers, &c.

Common Surface Fabrics.—Packing cloths and papers, brattice cloths for collieries, &c.

Double Textures.—Clothing, mail bags, hospital sheeting, &c.

Hard Compounds.—Knife handles, picture frames, trays, mouldings, furniture ornamentation, panelling, veneers to imitate marble, ivory, ebony, and other woods, &c.

Miscellaneous.—Washable felt carpets, kamptulicon (of any colour), toilet mats, table covers, &c.

Flexible quick-drying varnishes. Paints for carriages. Painting or printing floor-cloth, table-cloth, &c. (will dry in a few minutes), enamels, of any colour, for enamelling papier-mâché, metals, &c.

PARKESINE.

Exhibitor.—A. Parkes (1112).

This extraordinary substance, which is here exhibited for he first time, is made by combining oil, chloride of sulphur, and collodion in certain proportions. A hardened mass is obtained which solidifies almost immediately. Parkesine is capable of being used for nearly every purpose to which india-rubber and gutta-percha can be applied, with the additional advantages of being excessively hard and indestructible, besides being perfectly transparent in thin plates. It is capable of being coloured either with an opaque pigment or a transparent colour. It forms a varnish, coloured or not, which is perfectly hard and impervious to moisture. For buttons, combs, knife-handles, and all other articles for which horn or ivory are generally employed, it is invaluable, as it is not only capable of being moulded or pressed into any form, but possessing a hardness almost equal to iron. Its insulating properties are very powerful, and it seems to be quite indestructible by damp. The inventor has as yet only made a few experiments on its uses; but it seems difficult to put a limit to them, more especially as it is stated that the cost of production, on a large scale, would only be about 6*d*. per lb.

WOOD, PLAIN AND ORNAMENTAL.

Exhibitors.—Blache and Co. (1042), W. Bollans (1044), R. E. Farrant (1068), R. Fauntleroy and Co. (1069), R. Fauntleroy and Sons (1070), Hollingsworth and Willoughby (1085), W. Oliver and Sons (1110), H. Raynbird (1117), A. Robertson (1119), J. Skilbeck (1127), W. Smee and Sons (1128), W. and A. Smith (1130), C. Steinitz (1132), T. Turnbull (1142).

The specimens of foreign wood exhibited are very beautiful. The purple wood, king wood, Hungarian and palm wood, snake wood, tulip wood, and a host of others, are here shown to great advantage. A good collection of English woods is contributed by Mr. Raynbird. They comprise oak, chestnut, lime, larch, birch, ash, and many others, and are grown principally in the Hampshire forests. The different veneers displayed upon the wall are worthy of notice, many of them being of enormous size.

VEGETABLE FIBRES.

Exhibitors.—**Agava Patent Hair Co. (1034), E. Blake and Co. (1042), M. A. J. Dahmen (1060), T. J. Dimsdale (1063), E. Hyde (1090), H. Kolle and Son (1094), G. and J. A. Noble (1108), P. L. Simmonds (1126), T. Treloar (1139), S. L. Swaab (1135).**

The artificial horsehair, shown in Case 1034, is made from the stringy fibre of the leaves of a certain species of *agave*, or aloe. When properly dressed and curled it can hardly be distinguished from the best horsehair in appearance and properties. The specimens of cocoa-nut fibre, and the manufactures therefrom, are numerous and excellent. The fibre is obtained from the husks of the cocoa-nut, and has been long made use of by the natives of Ceylon and India for the manufacture of coarse rope and fabrics. Since its introduction into this country, some twenty years ago, its use has increased daily, until it has become an important article of industry, giving employment to thousands of hands. The introduction of colour has been attended with great success, and many of the patterns exhibited are most artistic in their design and treatment. *Piassava*, or *bass*, is the fibre surrounding the end of the petiole or leaf stalk of several species of palms growing near Parà and Bahia. It was at first only used as dunnage for placing between sugar barrels; but a working brushmaker, of Liverpool, having found it useful, it soon began to be imported regularly, until it has become an important article of commerce. Some interesting specimens, illustrating the manufacture of paper from straw and other fibres, may be seen in Cases 1055 and 1120.

A series of examples of flax, treated in a peculiar manner, so as to resemble silk, are exhibited in Case 1035.

An instructive series of cottons from all parts of the world may be seen in Case 1058, sent by the Cotton Supply Association. Specimens of twelve generations of the best cotton, grown year after year at Delhi, prove that no deterioration takes place through transplanting the cotton plant from its American home to British India.

INDIA-RUBBER, GUTTA-PERCHA, &c.

Exhibitors.—**Clark and Co. (1049), P. B. Cow and Co. (1059), W. H. Everard (1066), T. Forster (1071), Gough and Boyce (1075), Gutta-Percha Co. (1078), J. L. Hancock (1079), R. E. Hodges (1084), W. Hooper (1086), J. Horsey (1087), T. Lee (1097), C. Macintosh and Co. (1101), F. MacNeill and Co. (1102), North British Rubber Co. (1109), S. W. Silver and Co. (1125), H. Tayler and Co. (1136), F. G. Trestrail and Co. (1140), T. H. Tuck and Co. (1141), J. Wansborough (1145), W. Warne and Co. (1146), Wells and Hall (1147), West Ham Gutta-Percha Co. (1148).**

As might be expected, the exhibitors of this important article are very numerous. But a few years ago india-rubber was used only to erase lead-pencil marks, now it is hard to say to what use it is not applied, from dressing combs to doormats, from ladies' bracelets to steam-engine valves. India-rubber, or caoutchouc, is the solidified milky juice of trees belonging to the genera *Ficus*, *Siphonia*, and *Urceola*, growing in Brazil, Columbia, Java, Singapore and Africa. At certain seasons of the year these trees are bled or tapped, and clay moulds of various kinds, mostly in the shape of bottles, are dipped repeatedly in the fluid and dried, until a sufficient thickness has been obtained. The clay mould is then broken out, and the hollow bottle remains, in which shape it is imported to this country. About the year 1819, Mr. Thomas Hancock, the uncle of Mr. J. L. Hancock, the exhibitor of Case 1079, took out his first patent for cutting these bottles into elastic bands for gloves, braces, boots, and other articles of clothing. His next improvement was the application of the schoolboy's furtive amusement of chewing india-rubber, to the purification and reduction of the bottle rubber to a uniform mass. The first "masticator" was a wooden hand-machine, but this soon grew into a more powerful iron machine worked by steam power. The next step was the introduction of naphtha, as a solvent, by Mr. Charles Macintosh, who prepared waterproof cloth by uniting two pieces of cloth or other fabric by india-rubber solution. Then came other patents, but principally one for cutting the rubber into threads, to be covered with cotton or silk, and woven into elastic fabrics. At last, in 1842, the great india-rubber revolution commenced by the discovery of vulcanization, almost simultaneously in Europe and America, by Messrs. Hancock and Goodyear. This was the most important step made in the manufacture. The great drawbacks to the use of india-rubber were its liability to become hardened by cold, and sticky by heat, besides being imperfectly elastic, but by combining sulphur with it, it was not only found to resist all changes of temperature, but it became perfectly elastic, springing back to its original size when stretched.

Vulcanization is effected in three ways—by rubbing together caoutchouc softened in naphtha, with sulphur, and heating to 320°; by immersing sheets of india-rubber in melted sulphur, and heating them to 320°; and by dipping in a mixture of bisulphide of carbon and chloride of sulphur. The chemical change that takes place in the caoutchouc is at present not well understood, the great practical fact being that it loses its stickiness and remains perfectly elastic at all temperatures. The last great improvement in the manufacture is the discovery that by continuing the process of vulcanization for a longer time at an increased heat, and under pressure, a hard black substance is obtained, which can be turned in a lathe, like ebony. Ebonite, or vulcanite, as it is called, may be applied to such an infinity of uses, that it would be impossible to mention more than a very few. Combs, cups, incorrodible bottles, ornaments of various kinds, insulators for telegraphs, telegraph cables, electrical machines, surgical instruments, tiles, paper knives, and a thousand other objects for use or ornament, may be made out of this valuable material.

A new combination of cork and india-rubber, under the name of kamptulicon, has lately been introduced. It is made by grinding cork cutter's waste pieces to powder, and incorporating it with india-rubber, by a masticator. Kamptulicon possesses great advantages over floor-cloth, in being warmer and more durable. It appears also to be capable of receiving patterns of a more artistic nature than the usual material; at any rate the taste displayed by the houses exhibiting kamptulicon far exceeds that brought to bear on the floor-cloth exhibited in other parts of the building.

This compound is fitted to take the place of the following substances:—enamel, ivory, buckhorn, whalebone, &c. It not only makes a good substitute for these materials, but in many respects is superior in reality to the natural substances. The hardest compound resembles marble; the next, ivory and buckhorn, and that which is still softer—buffalo-horn, and whalebone; and with the exception of marble, its durable properties exceed that of these articles, while its cheapness recommends it for all purposes. It is capable of being moulded into any shape, and receives impressions as clear and sharp as the finest ivory, and is susceptible of a very high polish.

GUTTA-PERCHA.

This material, which closely resembles india-rubber in its chemical composition and physical characteristics, is the hardened juice of the *Isonandra Gutta*, a tree growing only in the Malayan Archipelago. Its perfect plasticity when warm, and its capability of receiving the most delicate impressions, render it invaluable in many cases where india-rubber would be useless. It arrives in England in large irregular blocks of some pounds in weight, generally containing a large proportion of impurities in the form of pieces of wood, stones, and earth. The blocks are first cut into slices and then torn into shreds. These are softened by hot water and kneaded in a masticator, the stones, earth, and other impurities being gradually washed away by the water. After several hours it is found to be kneaded into a homogeneous mass, which is drawn into tubes, bands, or sheets as required. One of the most important uses to which gutta-percha has been applied is for enclosing the metallic wires used for telegraphic purposes. Its indestructibility by water, its plasticity and elasticity, and high insulating power, have rendered it particularly invaluable for this purpose. Its indestructibility by acids and corrosive chemicals has caused it to be used most extensively for carboys, photographic baths, and galvanic battery cells. It has also been introduced with great success into decorative art; the sideboard exhibited by the West Ham Company being quite a *chef-d'œuvre.* The whole of the fruit displayed in the curious frames and friezes of this beautiful work are cast from the natural fruit. The purified gutta-percha exhibited by Dr. Cattell is worthy of notice. By dissolving the raw material in a solvent invented by himself, and carefully filtering, Dr. Cattell obtains a solution which on evaporation leaves the gutta-percha in a pure milk-white condition. The amount of dirt and impurities contained in the commercial article are exhibited side by side with the purified material. The Gutta-Percha Company exhibit *one mile* of covered wire *perfectly* insulated, which is hardly thicker than common sewing-cotton. Some interesting specimens showing the method of joining the insulated wire when broken are placed on the table opposite.

NUTS AND SEEDS, AND THEIR USES.

Exhibitor.—P. L. Simmonds (1126).

This very instructive collection, comprising specimens of almost every application of nuts and seeds, should be examined in detail. Many of the specimens exhibited are unique. The way in which savages appear to have taken advantage of the natural forms of nuts and seeds for the purposes of ornament is not a little curious.

The woods, seeds, and other vegetable products are of so much interest to the naturalist, the merchant, and the manufacturer, that it is with regret that the consideration of those now exhibited are thus briefly dismissed. Interesting accounts of most of them will, however, be found in "The Technologist: a Monthly Record of Science applied to Art and Manufacture," edited by P. L. Simmons, F.S.S.

WOOLS.

Exhibitors.—**Berendt and Levy (968), W. Buxton (971), C. Dorrien (977), T. B. Fox (981), Gurdon-Rebow (984), Jowitt and Sons (992), G. Mannings (995), Duke of Marlborough (996), Royal Agricultural Society of England (1007), T. C. Sands (1011).**

The collections of British and foreign wools, which are exceedingly good, will prove of great interest to many. It must be obvious to all that it is quite impossible in a book of this class to do more than point attention to this class of useful articles.

Wool was first imported into this country in 1770. In 1771 the import was 1,829,772 lbs.; it is now above 126,738,000 lbs. This includes the wool of the sheep, lamb, and alpaca.

COTTON AND SILK.

Exhibitors.—**Cotton Supply Association (1058), G. Mason (1104).**

The present state of the cotton trade, owing especially to the failure of the supply of this article from the Confederate States of America, renders these collections of great value. The Cotton Supply Association are clearly proving that we have but to encourage the growth of cotton in other countries to render ourselves free from those difficulties which arise from an exclusive dependence upon one. Not only is the collection of cottons, exhibited in this Class, of great interest; but our colonial possessions, and many foreign countries, are exhibiting remarkably fine specimens of cotton. Amongst others, Brazil is especially remarkable in this respect. The importance of the trade of the United States in cotton, will be at once shown by the fact, that the computed total crop, before the civil war was commenced, was carefully estimated at 3,163,220 bales.

Silk.—The illustrations of British silk are always interesting; but it appears improbable that we shall ever be enabled to cultivate the silkworm in this uncertain climate to commercial advantage.

IVORY.

Exhibitors.—J. C Azèmar (965), S. and T. Barnes (966), T. R. Dutton (978), M. Fentum (979), C. Hastilow (985), J. Jacques and Sons (989), G. Lammler (993), E. Nuppnau (1001), C. Playne (1003), A. Salomons (1009), P. C. Sassé (1012), Straight Bros. (1014).

Ivory is the osseous matter of the tusks and teeth of the elephant, and of the tusks of the hippopotamus, and the horn of the narwhal.

From a valuable paper read by Professor Owen before the Society of Arts in December, 1856, we extract the following important notices on the growth and formation of ivory:—

"The substance of the teeth of other animals, besides the elephant, is an article of commerce. Formerly, the name ivory was given to the main substance of the teeth of all animals; but it is now, by the best anatomists and physiologists, restricted to that modification of *dentine*, or tooth substance, which, in transverse sections or fractures, shows lines of different colours, or striæ, proceeding in the arc of a circle, and forming by their decussation minute or curvilinear lozenge-shaped spaces. By this character, which is presented by every, even the smallest, portion of an elephant's tusk in transverse section or fracture, true ivory may be distinguished from every other kind of tooth substance, and from every counterfeit, whether derived from tooth or bone. It is a character, — this engine-turned decussatory appearance, — which is as characteristic of fossil as of recent ivory. Although, however, no other teeth except those of the elephant present the characteristics of true ivory, there are teeth in many other species of animals which, from their large size, and the density of their principal substance, are useful in the arts for purposes analogous to those for which true ivory is used; and some of those dental tissues, such as those of the large tusks of the hippopotamus, are more serviceable for certain purposes, especially in the manufacture of artificial teeth by the dentist, than any other kind of tooth-substance."

SKIN.

Exhibitors.—Barry Bros. (967), F. Puckridge (1005), H. Tucker (1017).

Although skins are exhibited in this Class, they will be treated of when the consideration of the Class devoted to leather is taken up.

LEATHER AND LEATHER CLOTH.

Exhibitors.—Leather Cloth Co. (1096), Reckitt and Co. (1118), G. Spill and Co. (1131).

Leather cloth is prepared by applying to cloth a mixture of oil, lampblack, resin, &c. The manufacture is one requiring some care and experience.

SIZE, GLUE, GELATINE, AND STARCH.

Exhibitors.—J. and G. Cox (974), R. Cope and Sons (973), J. Darney and Sons (975), G.M. Glass (982), J. Green (983), T. Nimmo and Co. (1000), Prockter and Bevington (1004), E. and J. Richardson (1006), E. Tucker and Co. (1016), F. Wright (1019), B. Young and Co. (1020).

The processes of treating skins by heat, for the production of size, glue, and gelatine, are well known. The specimens exhibited are, many of them, of very high quality.

The starches will be found well worthy attention, from their fine character.

COMBS,

Which are exhibited by Berthold and Phillips (969), J. Dobson (976), T. Heinrich (986), M. Hitch (987), J. Sisson and Son (1013), Straight Bros. (1014), R. S. Stewart and Co. (1015), J. Heinrich (1082), Scottish Vulcanite Co. (1121), and C. Morris (1107); and also small shells and shell-work, by Misses Billington (970), B. Jacob (988), M. M. Samuel (1010), J. Votieri (1018), have many points of interest. The ingenuity of manufacture displayed is frequently considerable.

FISHING-RODS, TACKLE AND ARCHERY.

Exhibitors.—T. Aldred (1035), W. L. Beloe (1040), J. Bernard (1041), Chevalier, Bowness and Son (1047), C. Farlow (1067), A. Gould (1076), Gowland and Co. (1077), Jones and Co. (1092), W. Peters and Sons (1114), A. & G. Wilson (1151), C. Wright (1152), J. Wright (1153), J. Peach and Sons (1113).

SALMON AND TROUT FLIES.

Exhibitors.—R. Anderson (1037), J. Morley (1106), W. L. Scott (1122).

Into the mysteries of the angler's pleasures, this is not the place to enter. Those who love to wander by our mountain streams, or by the larger and beautiful rivers of our country, in which the fish have not been destroyed by the process of manufactures, will find in the collections of the above exhibitors much that will interest them.

WAX AND WAX FLOWERS AND FIGURES.

Exhibitors.—Barclay and Sons (910), J. C. and J. Field (918), Mrs. H. W. Hemans (922), Knevett and Austin (923), Elizabeth B. Lambert (925), Isabella Lumsden (927), Eliza Makepeace (929), J. & W. Marshall (930), J. Mintorn (932), J. H. Mintorn (933), J. Pierson (938), W. Rich (940), Miss J. Shipley (945), Mrs. Symons (946), Mrs. R. Trewolla (948), Priscilla Wilkins (951), Margaret H. Willis (952).

The amount of skill displayed in this manufacture, the taste and fine feeling for nature shown in many of the productions, make us regret that so much industry and ability had not found a more lasting record for its labours than this perishable material.

ANATOMIZED LEAVES AND PRESERVED MODEL FLOWERS.

Exhibitors.—Matilda Allen (1036), J. F. Gates (1072), J. Hawe (1080), S. A. Pilliner (1115), M. Stevens (1133), W. Stevens (1134).

The patient skill required to produce those beautiful skeletons of the vegetable world has been great. The preserved flowers should be closely studied as aids to the study of botany.

TURNING.

Exhibitors.—J. C. Azèmar (965), T. R. Dutton (978), P. Johnson (991), E. Nappnau (1001), T. G. Olley (1002), C. Playne (1003), E. C. Ryley (1008), A. Salomons (1009), H. Miller (998), W. Camp (1046), J. Hinks (1083), B. Taylor (1137).

The examples of turning exhibited in this Class can scarcely, as specimens of handicraft, be said to belong to it. As showing the character of the woods, bone, ivories, &c., these examples are of much interest.

BASKET-WORK.

Exhibitors.—R. Adamson (1033), E. J. Cossens (1056), R. Cosser (1057), R. Giehr (1073), M. H. Heeks (1081), J. James, Jun. (1091), P. Latarche (1095), R. Lenton (1098), A. Mackay (1100), C. Morris (1107), T. Smith and Sons (1129), T. & J. Toplis (1138), S. J. Walden (1143).

MATS AND MATTING.

Exhibitors.—J. Danks (1061), J. S. Deed and Sons (1062), Shepherd, Briggs and Co. (1124), Wildey and Co. (1150).

Much might be written in commendation of these productions did our space admit of it. We can only, however, state that such productions are to be found in the Eastern Annex.

A large group of sundries, embracing cork and cork manufacture, brooms and brushes, umbrella handles, and numerous useful and ornamental things, are in this Class.

PERFUMERY.

(This constitutes the Sub-Class D of Class IV.)

Exhibitors.—J. and E. Atkinson (1163), Bayley and Co. (1164), Benbow and Son (1165), F. H. Breindenbach (1167), F. S. Cleaver (1168), Delcroix and Son (1170), R. B. Ede and Co. (1171), J. Gosnell and Co. (1173), Hirst, Brooke, and Tomlinson (1174), G. Keith (1175), J. Lewis (1177), R. Low, Son and Co. (1179), J. Moreau (1180), Phillipson and Co. (1181), Piesse and Lubin (1184), N. Price and Lyon (1185), J. Richardson (1186), E. Rimmel (1187), J. M. Robson (1188), J. T. Sanders (1189), J. Thompson (1190), S. Vickers (1191), Warrick Bros. (1192), J. Wharry (1193), Whittaker and Grossmith (1194), Yardley and Statham (1195).

Perfumed soaps, which are included under this head, differ as soaps in no essential particulars beyond their purity, from those already described under their proper head.

The popular impression is that perfumes are obtained by distillation, which, with regard to most flowers, is incorrect.

The odours of tuberose, jasmine, acacia, orange-blossom, violet, jonquil, &c., are only to be obtained in their natural fragrance by the process of enfleurage and maceration.

This process is based on a fact not generally known, namely, that pure grease, fat, butter, oil, has the power to absorb the odours of flowers, and to become perfumed when in contact with fragrant blossoms. Grease absorbs odour, as salt absorbs water from the atmosphere, then if such odorated grease be put into rectified spirit, the odour leaves the grease and enters the spirit.

Nice, Cannes, and Grasse, in the south of France, are the present chief seats of this process, and there are annually scented there about 200,000 pounds of grease and oil.

The manufacture of perfumery for home use, together with the quantity exported, involves a trade at the present time of more than a million sterling per annum, and which in a great measure is dependent on this 200,000 pounds of grease made in France.

Now this scented fat is to the British perfumer, what raw cotton is to the Manchester spinner.

Samples of grease, perfumed with jasmine, violet, rose, jonquil, orange-flower, and tuberose are exhibited by Messrs. Piesse and Lubin. Also oils of the same flowers.

The process of enfleurage and maceration may be described in few words. Greases thus perfumed were termed butters till within a period of the last twenty-five years, since which the word pomade has been more generally adopted; we thus had violet butter, jasmine butter.

In the Duchess of Grafton's account-book, 1765, there are repeated entries, "Orange Butter, 6s."

During the death of the flowers, "when they with winter meet," the makers of these butters, or pomades, employ their time in purifying the grease which is to be perfumed.

This is a labour of no little importance, and requires attention, as the fat has to be scrupulously cleansed from all animal tissue. Clarified fats are exhibited by J. Ewen (1175).

The general plan is to melt mutton and beef fat, with the addition of alum, salt, and nitre; then to wash it continually under a stream of water; finally, to re-melt the grease, with the addition of benzoin. This latter material has a very marked chemical action upon grease (not yet noticed by chemical writers), tending to prevent the grease from becoming rancid.

The flowers being now in bloom, the enfleurage commences.

Square or oblonged frames, lined with glass, termed *Chasses en verre*, are employed for this purpose; these châsses resemble in make a window with one square of glass, and having a frame standing three inches each side above the glass.

The glass is now covered with the purified grease, about a quarter of an inch thick, and upon this the freshly gathered blossoms are sprinkled; these châsses are then piled upon each other: thus the flowers become enclosed as it were in a flat box, with a surface of grease top and bottom.

The same grease remains, but the flowers are changed as often as they can be during the whole season of blooming of each particular plant, extending over a period of two to three months.

The perfumed grease is gathered together, melted and strained to free it from loose petals, &c., and put into tin canisters for exportation.

Arriving in England, the grease is now forced through a cylinder having slits in it at one end, which causes it to appear in the form of ribbon shavings; having thus a large surface, it is now put into coppers of ten or twenty gallons' capacity, together with pure rectified spirit, in the proportion of about eight pounds of the butter to every gallon of spirit; after standing together a month, the spirit is drawn off perfectly clear and bright, but containing all the odour that was previously in the grease.

The odours which rank next in value are those distilled, and, with the exception of rose and lavender, but few blossoms will yield odour by distillation.

Bark, wood, seeds, and leaves, however, such as cassia, carraway, thyme, cedar-wood, &c., give up their fragrance by this process.

The almost endless variety of essential oils, or ottos, in the market, are nearly in all cases the result of the distillation of the fragrant bearing part of the plant.

Few of the ottos thus obtained are employed for handkerchief perfumes, lavender and rose excepted, but are principally used for scenting soap.

Some odour-bearing fruits, such as lemon, bergamot, and orange, give up their odour by rasping and expressing the rind of the fruit; these being dissolved in spirit are so very grateful to the olfactories, that no less than 40,000 pounds of essence of bergamot are annually consumed in England.

Another class of perfumes is prepared by simple tincturation; that is, infusing the odorous material musk, vanilla, benzoin, ambergris, in pure spirit.

By these various methods the primitive odours are obtained, and their number actually in the market extends to about one hundred varieties.

The generality of perfumes used for scenting the handkerchief are mostly of a mixed character, harmoniously blended from the primitive odours, and called bouquets and nosegays of euphonious titles, such as Perfume of Paradise, Frangipanni, Stolen Kisses, Hungary Water, &c., and it is worthy of remark that those odours containing the products of the orange tree are even more popular than the rose.

Dry perfumes, such as the gum resins which exude so prolificly from various plants indigenous to the East, were naturally the first fragrant materials employed by our early fathers, and as such are repeatedly mentioned in the Scriptures, nearly every one of which are still in use in the laboratory of flowers, and give rise to considerable trade at the ports of Smyrna and the rocky city of Petra.

The incense burners depicted on the tombs of ancient Egypt, Meroë and Memphis are still represented at the International Exhibition of 1862, by the elegant sweet fumigation vase for burning or rather volatilizing the sweet savour of incense.

Perfumery manufacture does not confine its limits to deal with fragrant substance. The dyer is not satisfied with the pristine whiteness of cotton, he stains it with aniline, archile or anatto, as fancy dictates; so with the perfumery factor, inodorous bodies he makes redolent. Starch becomes Violet Powder, soap becomes Old Brown Windsor, glycerine becomes Crême de Mauve, which will make lank tresses as bright and crimp as a raven's wing. Water is impregnated with elder flowers, and fat is inoculated with orange blossoms, so that by the least deceivable of our senses we know not the one from the other; these and other accessories to the toilet of fashion and beauty divide the manufacture of perfumery into about twelve sections, independent of the work of the flower farmer, who produces the raw odorated fats and oils before alluded to.

Section 1 embraces the manufacture of smelling-salts and odorous vinegars; samples of these are to be seen at the various stalls of exhibitors in Class IV.; liquid ammonia and bicarbonate of ammonia constitute the base of smelling-salts, scented with various ottos put into bottles either upon sponge or in a semi-crystalline state. Aromatic vinegar; that is, concentrated acetic acid, aromatized with camphor, &c., is also put into smelling-bottles upon sulphate of potass, and in this state is called crystallized vinegar.

The manufacture of elegant gold, silver, and aluminium smelling-bottles to contain the above is of no mean importance as a branch of the jewelry trade.

Diluted forms of scented vinegar, under the names of Toilet Vinegar, Four Thieves' Vinegar, Cosmetic Vinegar are also extensively exhibited.

Mr. Rimmel making a speciality of toilet vinegar.

Section 2 embraces sachet powders, absorbent powders, &c.

The sachet powders consist of dried flowers, odoriferous gums, and precious spices. Almost every lady's wardrobe contains a sachet for perfuming the linen after the laundry process, or to prevent moth. There are about twenty-four varieties of sachet powder in Atkinson's list.

The absorbent powders, for drying the skin after washing, are an important class of toilet requisites, many tons of which are manufactured from wheat, starch, and talc powder, and are used in the nursery of children.

Sections 3, 4, 5, include cosmetics proper, which are made either to "increase the force of beauty," or to arrest time stains.

Of cosmetics, cold cream of roses is perhaps the greatest favourite; its reputation has lasted from the days of its inventor, Galen, 1700 years. The English perfumers appear happy in this manufacture; cold cream anglaise is to be found throughout all Europe.

Milk of almonds, emulsion of pistachio nuts, olivine, jelly of jasmine, are favourite preservers of the skin, and it must be admitted that they are of service; the oil which these emulsions contain in a globular state, applied to the skin, preserves it against the inclemency of our seasons.

It is difficult to ascertain what is the annual consumption of silver in the manufacture of hair-dye, but we have good reason to know that the quantity is far beyond the ordinary belief of those even who are used to abstract statistics; still, from the difficulty of staining the living hair, the problem of making a universal hair-dye has yet to be solved, and some curious phenomena are occasionally seen in the way of green and purple hair, which results from the chemistry of the hair-cutting room. Mr. Condy, whose energies are devoted to the study of manganese, produces a most excellent *brown* hair-dye, consisting of permanganate of potassa, under the euphonious title of Condy's Baffine Fluid, which, though the article is excellent for its purpose, the public are rather uncertain whether the fluid is "to polish dining-tables," or is a "piquant sauce."

Sections 6, 7, 8, take in the manufacture of unguents, oils, balsams, hair-washes, bandaline and other dressings for the hair.

The mane of the British lion appears to give him a great deal of trouble to arrange and to beautify before he considers himself fit "to enter society." Atkinson has rendered himself famous for his bears' grease, but whether the article sold is the veritable fat of Bruin, ill-natured people doubt; however there is a liberal show of it in this class, every one of the perfumers having some special panacea for making hair grow, and the most notable of our time appears to be pistachio nut oil, expressed from the kernels ol the *Pistache vera* of Spain; and such is the present consumption that pistachio nuts, to use a Mincing Lane phrase, have "gone up" from £5 per cwt. to £12, with every prospect of "further rise."

Whether SHAMPOOING was ever an eastern practice, we must leave to Mr. Layard and other oriental scholars to inform us, but it is certain that this modern habit has been introduced from America by the Figaros of New York. American Bay Rhum, or Hair Water, appears to contain hartshorn and cantharides with a scented spirit.

Sections 9, 10, are important branches of the perfumers' trade, consisting of the manufacture of scented soaps for washing, which are, or should be, hard, and of shaving-cream, which is soft and honey-like.

The removal of the excise duty on soap gave a most valuable impetus to this trade. Refined scented soap was only known as a luxury, but now it is of universal employment, and ranges in price from 1*s.* to 20*s.* per pound. Some of the scented soaps varying in price from 4*s.* to 10*s.* per pound are very exquisite, such as rose soap, bergamot, commonly called spermaceti soap, frangipanni soap, and numerous others. Mr. Cleaver being the maker of the famous honey soap, scented with otto of citronella from Ceylon. Messrs. Low, Son, and Hayden are in high repute for their scented soap; Paris's old brown Windsor soap is still and will remain from intrinsic merit a favourite detergent. Pear's transparent soap, invented by the father of the present exhibitor, is worthy of notice; but the firm is prevented from obtaining the full benefit of the invention by the excise duty on the spirit which is necessary for its manufacture; the consequence is that German and American transparent soap is imported into this country, and the inventor is undersold at his own door.

Piesse and Lubin's specimen of cold cream soap is pressed into notice; it consists of a fine curd soap in which the free alkali is nearly all neutralized by the addition of wax and spermaceti.

There is a great variety of other named soaps, from the sublime "sultana" to the ridiculous "turtles' marrow."

Sections 11, 12, combine the making of dentifrices, mouth-washes, opiates, and tooth pastes, breath pastils, &c., nail powder, rouge.

Dentifrices consist principally of antiseptic and astringent substances, and a hard base to act as rubbing material; such as Peruvian bark, cascarilla bark, cassia bark, bole ammoniac, burnt horn, precipitated chalk, charcoal mixed in various proportions with orris root and some peculiar perfume.

Mouth washes and tinctures principally contain spirituous infusion of cedar wood, gum myrrh, rhatany, cloves, to which is added otto of roses and peppermint.

The total value of perfumery imported in 1860 was £274,350.

The average annual importation of some natural productions used by the perfumer for the past five years has been given by Mr. S. Piesse in his work, 'The Art of Perfumery,' as follows:—

Musk – – –	9388 ounces.
Rose – – –	1117 "
Vanilla – – –	3525 lbs.
Ambergris – –	225 ounces.
Civit – – –	355 "
Orris root – –	420 cwt.

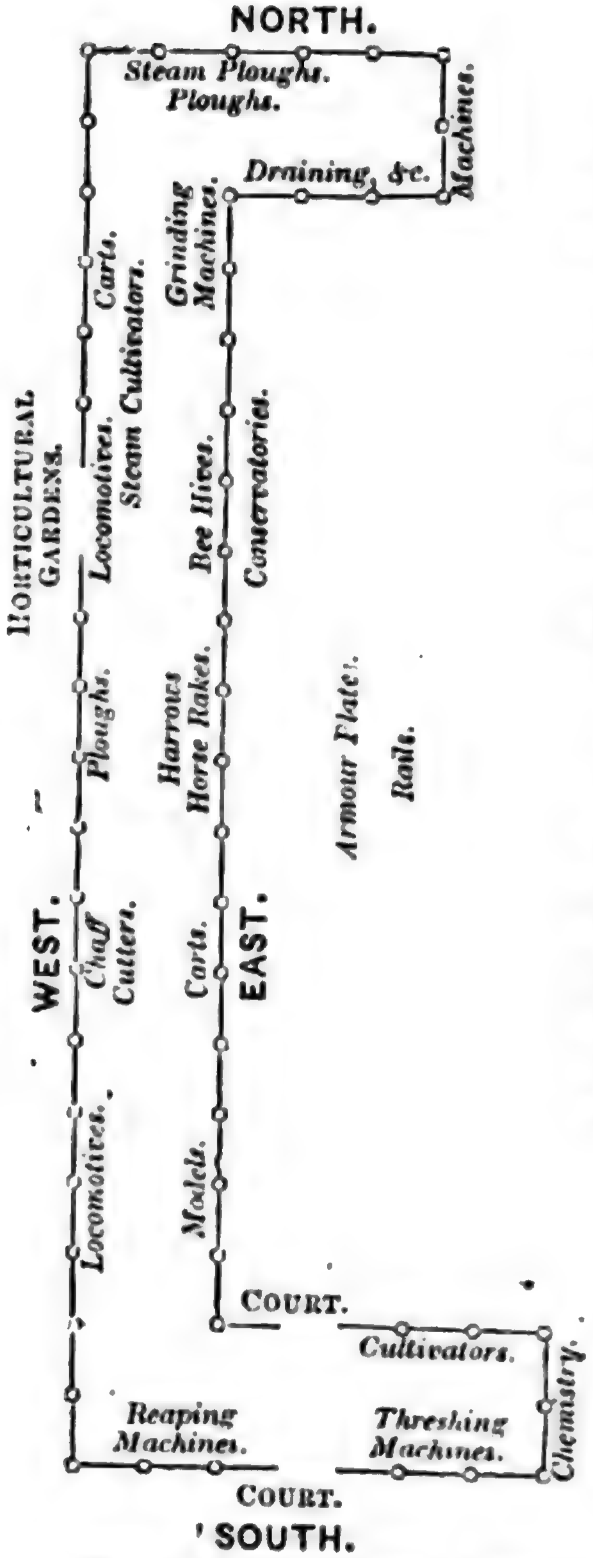
Among other goods exhibited is an elegant perfume fountain, designed by M. Septimus Piesse, and executed in terra-cotta by Blashfield. It represents Christiana, daughter of Linnæus, watering some favourite plants with an arrosoir: the whole figure stands without plinth four feet high. The statuette is so contrived that water or perfume may perpetually fall from the arrosoir, thus becoming a falling fountain, a pleasing tribute to the great botanist.

Two trophies, as they have been called—which term I should wish to apply only to real triumphs of human industry—find their places in the nave; one of these being devoted to *Food*, and the other to *Vegetable and Animal Substances* employed in manufatures.

THE LIVERPOOL CASE OF IMPORTS, which is exhibited in the Central Avenue, belongs also to this class. A more valuable or instructive collection than this one is not to be found within the Exhibition building. In 1851 a similar collection was exhibited, as arranged by Mr. T. G. Archer, then of Liverpool, now of the Industrial Museum of Edinburgh. The present collection has been arranged entirely by Mr. Charles Spence, a gentleman well qualified by his position in the commercial world, and his especial qualifications, for the task. Everything which has been introduced since 1851 through the port of Liverpool into this country has been added; and the arrangement of the whole is in the best possible manner.

To enumerate and describe the articles exhibited would be to produce a volume, and one of much interest might be written on the Liverpool imports. Everything is so fully labelled that those who examine the case will require no Handbook for their guidance.

CLASS IX.—AGRICULTURAL AND HORTICULTURAL MACHINES AND IMPLEMENTS.



Number of Exhibitors, 136.

SITUATION OF CLASS (Eastern Annex).—*This collection is situated in immediate connexion with the Chemical and Mining Class in the Eastern Annex. It may be entered from the Open Court belonging to Class I., or through the Chemical Class turning to the left. This large Class extends the entire length of the Western branch of the Eastern Annex, and unites at the end of the large Open Court with the section devoted to Machinery not in Motion.*

Position of Groups.—The collections of the different exhibitors are kept together; and as the more important manufacturers of agricultural machines and implements exhibit most of those which are employed, it is not practical to give, as a guide, the positions of groups of objects beyond those indicated in the Plan.

AGRICULTURAL STEAM-ENGINES.

Exhibitors.—Aveling & Porter (2073), Barrett, Exall, and Andrewes (2078), Brown and May (2085), W. C. Cambridge (2089), Coleman and Son (2095), Clayton, Shuttleworth, and Co. (2094), Garrett and Son (2117), John Gray and Co. (2119), Holmes and Son (2129), Hornsby and Sons (2130), Humphries (2134), Ransomes and Sims (2168), Robey and Co. (2172), Ruston, Proctor, and Co. (2175), E. R. and F. Turner (2194). Tuxford and Sons (2195), Wilkinson, Wright, and Co. (2203), Burrell (2087), Messenger (2151).

The application of machinery has been most beneficial to agriculture, and has contributed more towards its advancement and the social improvement of the labourer than any other of the numerous circumstances affecting land. In districts where the work of the farm is carried on by manual labour, the man is valued more according to his physical than to his mental qualifications: the latter is probably neglected or checked, as tending to make him dissatisfied with his condition, or at all events, as being useless to, or interfering with, the machinery of his muscles, and thus lowering his animal value to his employer. In such a district, the introduction of machinery is generally viewed with suspicion and distrust, from an idea that, by replacing manual labour, it must injure the existing labourer. But a little consideration will soon convince all of the error of such an opinion, as *the machine* can only represent *one* power, the physical (strength), whereas *the man* consists of *two*, the physical and the mental, or (skill,) to which the first is materially subject. If, therefore, we desire to improve the condition of the labourer and to develop his power, which is his value, to its fullest extent, we are acting in our own interest in giving up as much as we can of the *merely* physical (strength), in order to cultivate as much as possible the higher and more valuable faculties, those of the mind (skill). In this the interest of the employer is surely as deeply concerned as that of the employed. Here it is that the machine comes to our assistance.

The force of this argument is proved by the very fine display of machines in this collection, which it is necessary we should concisely describe. To commence with the steam-engines: it should be remarked that the principal points to be sought for in a steam-engine are, that its effective power shall bear as high a relation as possible to its absolute power; (simplicity of construction, by reducing unnecessary friction, gives this); that the fullest effect shall be given to the combustion of the fuel used, so that the largest amount of power may be obtained, and the largest quantity of water evaporated: this is done by surrounding the fire with the boiler, by increasing the heating surface by means of placing tubes through the boiler, and by coating its exterior with felt or wool to prevent loss of heat by radiation; that the strength of all its parts should harmonize; that they should be easily accessible for the purpose of cleaning or repairing, and that the engine should be made as light as possible, consistent with a due regard to strength and durability.

In Aveling and Porter's locomotive engine there are many nice adjustments. This engine has an improved patent extra-large boiler, fitted with thirty-seven 2¼-in. tubes, external plates of the best Butterley iron, fire box and tube plates of Bowling iron, with extra stays for high pressure; the fire grate measures 31 in. by 34 in. and is suitable for wood or coal fuel. The cylinder, 10 in. diameter, is surrounded by a jacket, and placed on the forward part of the boiler, by which arrangement priming in ascending steep inclines is prevented. The engine is remarkable for its simplicity and the strength of its working parts. It is capable of drawing 10 tons up an incline of 1 in 6, and can be readily managed by any ordinary engine driver.

Barrett, Exall, and Andrewes, are exhibitors of an engine which appears to embrace all the more recent improvements.

In Brown and May's engine the arrangement of the cylinder is such, that being enclosed in a belt or jacket of steam, it is kept, when working, at a high temperature, and thus the maximum advantage of using steam expansively is attained. All danger from fracture, through ice in the cylinder in frosty weather, is also obviated; the ice melting as the steam gets up.

The lower part of the cylinder casting forms a steam chamber, from which the driest steam is taken off, directly into the valve case, without exposure to the cold air; this is very important, as condensation and the liability to prime is thereby obviated.

R. Garrett and Son have a portable engine, in which, without possessing any remarkable novelty, will be found the greatest perfection in all the details of manufacture.

Hornsby and Sons have a double cylinder steam-engine. These exhibitors and patentees state that great advantages are attained by their principle, in which the cylinder and the pipes connected with it are placed inside the boiler or steam chamber. They are thus protected from weather, and all condensation in the cylinder is prevented.

In engines with the cylinder outside the boiler, the water, in the winter season, frequently becomes frozen, and even with the greatest care on the part of the person in attendance, much injury is done or time lost.

On the other hand, in cases where the cylinder is for protection placed inside the smoke-box, a greater complication and weight of parts is necessary, the smoke-box having to be made sufficiently strong to take the whole strain of the engine, and increased in size so as not to impede the draught.

Ransomes and Sims' portable engines, with their multitubular boilers, are ingeniously constructed, combining much simplicity, with apparently the promise of great durability.

In estimating the power an engine will produce, the size of the cylinder is only one element, and by no means the most important, for it must be borne in mind that the power really depends on the capability of the boiler to generate dry steam as fast as the engine can utilise it. In a portable engine the size of the boiler is limited by the condition that the engine must be easily portable. Ransomes' engines are furnished with boilers as large as is compatible with that condition. These engines have a moderate-sized cylinder and a quick speed, in preference to a large cylinder and a slow speed, as possessing many substantial advantages, and it will be found in practice that these engines will produce as much power, and cost as little to keep in repair, as any others of equal weight and portability, but furnished with larger cylinders.

Messrs. Robey and Co., of Lincoln, have a 10-horse double-cylindered traction engine, which is adapted to be readily moved from farm to farm, with threshing or any other machines attached, and to be used for all agricultural purposes.

E. R. and F. Turner, of Ipswich, exhibit a portable steam-engine, possessing the following characteristics:—

The cylinder is 6¾ in. diameter; length of stroke, 10½ in. The fly wheel, which serves also as a driving pulley, is 4 ft. 4 in. diameter, and makes 140 revolutions per minute. The crank shaft is of wrought iron; it admits of the fly wheel hanging on either end, and of an additional driving pulley. The feed pump has two delivery valves and a tap to regulate the quantity of water. The pump valves, slide valve, cylinder, piston, and every part of this engine are so constructed as to afford the greatest facility for repairs or adjustment. The boiler is of the ordinary locomotive form. The fire-box is of Low Moor iron, the tubes are twenty in number and 2½ in. diameter. There is a plug at the top of the fire-box which fuses at a low temperature, thus preventing any serious accident arising from the water getting too low. The exterior of the boiler and cylinder are clothed with wood, and neatly cased over with sheet iron. The use of fusible metal as a safety metal is becoming of general use. This metal is a compound of bismuth, lead, and tin. According to the proportions in which the alloy is made, so are its melting points changed.

8 parts of bismuth,	5 of lead,	3 of tin,	melt at 212° F.
2 ditto	1 ditto	1 ditto	201° F.
5 ditto	3 ditto	2 ditto	199° F.

By increasing the quantity of tin and reducing the proportion of bismuth an alloy is formed which will not melt until a very much higher temperature is attained.

In addition to the above there are several very excellent fixed engines, exceedingly well adapted for agricultural purposes. These are exhibited by those who have sent the locomotive engines described, and others named in the list given. For a general description of such engines the necessities of a limited space compels me to refer the reader to the section devoted to MACHINERY IN GENERAL.

STEAM AND HORSE PLOUGHS AND CULTIVATORS.

Exhibitors.—W. Ball (2075), E. H. Bentall (2079), The Bushby Implement Co. (2088), C. Burrell (2087), R. Chandler (2091), C. Clay (2093), Coleman and Sons (2095), J. Comins (2096), Crowley and Son (2103), J. Fowler (2115), J. and F. Hancock and Co. (2124), W. Hensman and Son (2126), Hornsby and Son (2130), J. and T. Howard (2131), Hunt and Pickering (2135), Leach (2143), E. Page and Co. (2161), Ransomes and Sims (2168), Samson and Jewell (2177), G. Sellar and Son (2181), W. Snowden (2187), W. Steevens (2189).

From the earliest ages since man was condemned to become a tiller of the ground, the plough has been a valuable implement to him: in the pages of the Bible not only is the plough frequently referred to, but even its particular parts are specially named, and many ancient monuments in Eastern countries bear testimony to its existence and to its outward form. In these days, the plough was considered of even higher value than it is with us; and in later days, if we read the beautiful works of the Greek and Roman historians, we shall find much that will instruct us, both in the ploughs then in use and their practical application in the field; even minute points are so particularly described and explained as to give good evidence of the value they attached to the implement and its uses. The Romans introduced their agriculture into western Europe, and for some years their plough was the one in general use. A series of improvements gradually effected a great change in its appearance, as we find in our early English writers frequent mention made of the ploughs, the construction of which is fully described, as well as directions for using them; yet our records are often very conflicting and unsatisfactory, showing, at all events, that agricultural practices were local, as in the Cotton MSS. we find a description of ploughs with wheels.

Professor Kaun, of the Agricultural College of Hohenheim, kingdom of Wurtemburg, illustrates the origin and history of traction tillage by a hundred beautifully constructed models of ancient and modern implements, appositely enough exhibited upon Mr. Fowler's gallery, where, in the steam-driven plough, the series culminates. The first class consists of ploughs originating from the trowel-shaped hand hoe, and these are divided into five varieties. The first form was a simple share, inclined like the cutting part of the hoe, but there was no mould-board. The second form had a horizontal share, but still without a mould-board. Then came an inclined or horizontal share, with two narrow mould-boards. In the fourth variety the share is inclined, and the mould-board in the middle. Lastly, the mould-board became fixed at the side, and this type has been developed into the perfect implements of Ransome, Howard, and Hornsby. The second class is that of ploughs originating from the spade, from which have descended the short, upright mould-boards that grub the American prairies, and the continental model plough of Brabant. The third class is of ploughs originating from the two-pronged hoe; and the fourth class is that of turn-wrest, side-hill, or one-way ploughs. A light soil, dried and baked under a fervid sun, needs but the stirring and crumbling of a pointed wedge, set at an angle below a draft beam, and, for the sake of making an open furrow, held tilted on one side by a handle grasped by the ploughman.

The non-agricultural visitor may be informed that the principal distinction between ploughs consists in the presence or absence of fore-wheels. The former are termed wheel-ploughs, the latter swing-ploughs. The wheel-ploughs are made either with one wheel to run upon the land, or with a second wheel (larger than the other), to run in the furrow; and as these can readily be shifted, the plough can be set to any width or depth of furrow desired.

In *Swing-ploughs* we have several plans for reducing the friction on the sole of the plough. In the ploughs exhibited by the various makers, it is desirable to pay special attention to the form of the beam, and the mode in which the draught is applied and regulated by means of the bridle or hake attached to its extremity. The coulter and the share, their shape and method of adjustment, are important points in a plough. The mould-board, or turn-furrow, upon which the value of the plough so mainly depends, is, by common consent, still left as an undecided question; so difficult is it to devise a form that shall be applicable to all soils, or even to the varying conditions of the *same* soil. As these two descriptions of ploughs have each of them their advocates, the wheel-ploughs being chiefly used in the South, and the swing-ploughs in the North, it may be well to give a brief summary of their comparative advantages.

By the *Wheel-plough* the work generally is more easily performed, and it is done more uniformly both as to depth and width of furrow-slice, inasmuch as the wheels, when set, serve for gauges. Shallower ploughing can be effected by it—a point of importance where the soil is very thin and very stony. In some such cases a swing-plough could not be held in the ground at all.

By the *Swing-plough*, a good ploughman can adjust his furrow-slice by altering his line of draught, by means of the plough-bridle or hake, and he can regulate it (as in crossing a furrow) by the leverage of the handles or stilts. He can thus plough across the ridges at an uniform depth, and he can work with it on almost all soils and in all weathers when ploughing can be attempted. The swing-plough is simpler in construction, cheaper in cost, and less liable to get out of order than the wheel-plough.

In the use of the wheel-plough *more judgment than skill* is required, as the whole of its working depends on the harmonious arrangements of its different parts (the wheels, draught, &c.), less depends upon the ploughman, and more upon the implement, than in the swing-plough. In that *more skill than judgment* is required by the ploughman, long practice will only make him master of it; but when once he has arrived at that point, he will probably do his work, under ordinary circumstances, better than with the wheel-plough.

Clay's Patent Cultivator and Eradicator.—This implement is applicable as a broadshare, scarifier, cultivator, grubber, eradicator, and dray harrow. The tines are mounted upon revolving bars, and are made so as to *raise themselves* out of the soil *backwards*, similar to a horse rake when turning the ends of the "bouts," or when it is requisite to relieve the implement from twitch or other rubbish with which the tines happen to become choked up. The tines are simply fixed with steel wedges, so that their number can be increased or diminished at pleasure, to suit the state of the soil.

A fine collection of ploughs are shown by Ransomes and Sims of the most improved construction. Space will not allow of a description of more than one of those exhibited. The trussed beam iron plough is therefore selected.

This plough forms one of a series of four ploughs, three of which were awarded prizes at the last ploughing-match of the Royal Agricultural Society of England, at Warwick. This is the medium-sized plough of that series.

The *handles* are of sufficient length to give perfect command over the ploughs.

The *beam* is on the patent trussed principle, by which greater rigidity and strength are secured, with the same weight of metal, than can be by an ordinary solid beam. This construction of the beam also permits the coulter to be placed quite centrically, so that it does not require to be necked.

The *wheels* are carried on one cross bar, the advantage of which is that they can be more firmly fixed in any desired position, and can be more quickly shifted than when they are carried on two separate bars, also that the whole wheel fastenings are rendered extremely simple.

The *draught* is taken directly from the head.

The *share* is fixed to a wrought-iron movable lever neck, which allows it to be set with more or less pitch, as may be required, and the arrangements for fixing the neck in the desired position are very simple and effective. The form of the share and of the mould-board is the result of a series of careful experiments on a variety of soils. They will be found to leave the furrow-slice neatly turned over at an angle of 45°, leaving the upper edge full and sharp.

The *skim coulter* is a very useful addition to a plough, particularly when ploughing clover, ley, or stubble. It just pares the surface, and turns into the bottom of the furrow all long grass, weeds, stubble, &c., which are then completely buried and enrich the soil by their decomposition. A weight attached by a chain to the coulter is often used when the grass is long, to assist in drawing everything cut by the skim coulter into the furrow, so that it may be thoroughly covered. This chain is also useful when ploughing in manure.

The collection by these exhibitors includes a great variety of ploughs for ordinary use, and principally of wrought iron: they have the chief necessaries of ploughs, namely, rigidity and strength. The handles are of sufficient length to give perfect command over the plough. The form of the furrow is what is termed "crested," but mould-boards may be applied which will produce any form of furrow, and by attaching to the frame a pair of open-ribbed mould-boards, it is adapted for raising potatoes.

Richard Hornsby and Sons are also exhibitors of many very beautiful ploughs, which, whether regarded as examples of manufacture, or examined for ingenuity of construction, cannot but be admired.

Hancock and Co.'s Pulverising Plough.—This implement ploughs the land into a garden tilth, instead of into large clods and glazed masses as all other ploughs do. Three shares are arranged, one behind and below the other, with means for adjusting them to any distance from one to four inches apart from each other, so that it will thus break up the soil fine enough for sowing roots or grain from three to twelve inches deep at one operation. The turn-furrows are removable, by which any portion of the dirt may be turned or not; and it is capable of many modifications for various purposes on the farm.

Hancock's Patent Pulveriser Plough represents the turnover and non-turnover systems combined in one implement, and is one of its most useful arrangements. In this form it is used for three very important operations, viz.—

First, for putting in manure on stubbles for tares or cabbages, skimming the manure off one inch thick, and turning it over and covering it with two inches more of broken-up soil, and subsoiling below, three or four inches deeper at the same time: thus we have deep culture and shallow covering of the manure, which are the best means of securing a healthy and vigorous growth of the plant.

Secondly, for autumn culture on clean stubbles, for putting in manure or not, smashing up ten or twelve inches deep, and only turning five or six inches of the top soil.

Thirdly, for making a seed-bed five or six inches deep on poor subsoils, say, turning three or four inches of the top and subsoiling as much below. A few years of this system, brought to bear upon the poor subsoils, would soon double their productive value; and in all cases this system is invaluable for breaking up the "old pan" formed by the horses walking in the furrow. When the pulveriser is worked in the above form, the horses must walk on the land and not in the furrow, which gives practically the full advantage of steam tillage, but at far less cost. Three horses will make a seed-bed at the rate of an acre per day.

STEAM PLOUGHS.

The introduction of steam ploughs must be regarded as recent; several excellent examples are exhibited. Although the details of arrangement are very different, yet, to a certain extent, the same general principle prevails in all. A steam-engine, such as one of those already described, an anchor and a balance-plough, mark each variety.

On the side of the field is placed the engine with its windlass: in the arrangement of this there are many peculiarities to insure facility of working. On the opposite side of the land is placed the anchor. Burrell's anchor is a good example.

This anchor is made to resist the side strain of the implement worked, by the cutting into the ground of the disc-wheels, and it is moved along the headland at pleasure, by the motion of the 5-ft. sheave, which is turned by the ploughing-rope, and as the plough goes away from the anchor the sheave winds up a rope stretched along the headland, and keeps the anchor opposite its work. The frame is made entirely of wrought iron. The steering of the disc enables it to be worked along a crooked headland. The box at the back is intended as a counterpoise to prevent the anchor being pulled over when doing very heavy work. This machine is managed by a boy, who also attends to shifting of rope porters.

The windlass is extremely simple in structure, is moved on four wheels, and its peculiarity consists in having the motion from the centre instead of the side, which makes it much safer, as there are less accidents in the breakage of the leather band, by which it is worked from the engine. Imagine three iron pulleys separately rotating upon a hollow but light and strong spindle; the outside pulleys alternately working a drum, round which a wire rope is coiled, just as either one or the other is put in or out of gear; and the centre pulley for the band when neither of the other pulleys are required to work. The wheels can be cased over with an iron plate, so as to preclude the possibility of the rope getting entangled with the wheels, as is frequently the case when the motion of the windlass is from the side instead of the centre. On each side of these centre pulleys are two large drums, which coil and uncoil the ropes attached to the implement; and these drums are acted upon by a break, very simple in its structure, but exceedingly effective, as it is pulled by the man at the anchor by means of a light rope, which instantly puts the windlass out of gear.

James and Frederick Howard exhibit some exceedingly ingenious arrangements in their steam ploughs. Chandler and Oliver show their patent system of steam cultivation, by which they state, that any size or shape of field can be cultivated in any direction without shifting the engine or tackle.

In connexion with steam cultivation there are various kinds of windlass exhibited. Hayes' patent windlass claims much attention.

The merit of this invention is, that in all other windlasses yet invented or manufactured for this purpose, they are obliged to stop the cultivator when it reaches the headland by stopping the engine, which stoppage must be effected by one or more signals to the engine-driver, the view of the engine-driver to the cultivator often being impeded by fogs, hilliness of fields, hedges or trees, or the smoke and steam from the engine. In the case of the Patent Windlass, the anchormen, who stand on each side of the field waiting the return of the implement, have the means of instantly stopping it in any part of the field, thus preventing breakages caused by running into the turntables, and other accidents; and this is effected without having to stop the engine, or the driver having care of anything but his engine, as in threshing or ordinary work, saving the loss of time in stopping and starting, the labour of the man, and all risks.

The combining, paring, and breaking cultivator, exhibited by Sampson and Jewell, will do from three to four acres a day, performing the work of a skim-plough, harrow, and scarifier at one operation; it also acts as a turn-plough for sowing all kinds of seeds.

In every division of this Class will be found ploughs and cultivators of great excellence.

AGRICULTURE CONTINUED IN PART III.

CLASS IX.—AGRICULTURAL AND HORTICULTURAL MACHINES AND IMPLEMENTS.

PART II.

ROLLERS AND CLOD-CRUSHERS.

Exhibitors.—**Amies and Barford (2071), W. C. Cambridge (2089), R. Chandler (2091), J. Boyd (2084), Comins (2096), A. and E. Crosskill (2101), W. Nicholson (2158), W. Croskill (2102), Coleman and Sons (2095), Hill and Smith (2128).**

The uses of the roller and the clod-crusher are so well known that they need but little description. The jointed clod-crusher of Coleman is ingeniously made to accommodate itself to the undulations of the ground. From the peculiar construction of its discs it is well adapted for abrading the surface of the soil. The self-cleaning clod-crusher and roller exhibited by the trustees of W. Crosskill is equally well contrived. Those of Crosskill and Co., and of Cambridge, have long been in general use, and have been universally admitted to be most effective assistants in obtaining that tilth so necessary for the reception of seed, as also for consolidating the ground after the frosts of winter, or when the young plant (corn) is attacked by wireworm. These implements consist of a series of cast-iron rings freely and independently moving on an axle, to which is attached a stout wooden frame with shafts for the horse. In Crosskill's these rings have deep serrated edges, with stout spurs projecting laterally between them. In Cambridge's the rings are somewhat broader, plain on their extreme periphery, but hollowed out on either side to the depth of 1½ inches, thus giving the horizontal line a sulcated (furrowed) appearance. The objection to these crushers or rollers is, that they can only be used when the surface is tolerably dry, as otherwise the interstices between the rings hold the dirt, and they speedily clog up. This has led to the

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introduction of an improved or double roller, in which the rings are mounted on two parallel axles, and fixed at such distances from each other on the axles that those on the last shall move in lines between those on the front axle.

In this manner one-half of the surface is acted upon by the first row, and the remaining half by the second row.

Nicholson's Patent Double-cylinder Garden Roller is a most perfect and effective instrument, and being finished by machinery, is little liable to disarrangement. It is used with little labour, and can be turned round without injuring either grass or gravel.

HARROWS.

Exhibitors.—**T. W. Ashby and Co. (2072), W. C. Cambridge (2089), J. and F. Howard (2131), E. Page and Co. (2161), B. Sharpe (2183).**

Ashby's rotating harrow has been much approved of; as are also the chain harrows of W. C. Cambridge. The grass harrows of B. Sharp are used with great advantage on grass or other crops. One of the first and principal conditions in farming, as in gardening, is to obtain as fine a tilth as possible: this condition is desirable during the whole period of cultivation, but more immediately of importance during its earliest stages. The implement that the farmer chiefly relies upon to effect this end is the harrow; and therefore it is natural that this important implement so universally used, should be regarded with great attention both by him and by the machine-maker, so that the skill of the one may carry out those alterations which the practice of the other may from time to time enable him to suggest for its improvement. Unlike those machines of modern invention of which we have just spoken, the history of the harrow would probably take date with that of the plough. In the pages of the Bible we find mention made of it; and in the works of the Roman writers on agriculture we find copious descriptions of the different kinds of harrows then in use, descriptions which comprise all the various sorts of modern times, and resemble those very closely still in use in some of our remote districts.

HOES AND RAKES.

Exhibitors.—Carson and Toone (2090), T. W. Ashby and Co. (2072), Busby Implement Co. (2088), C. Clay (2093), J. Comins (2096), J. Coultas (2098), J. Eaton (2111), A. and T. Fry (2116), J. and T. Howard (2131), Hunt and Pickering (2135), E. Page and Co. (2161), Priest and Woolnough (2165), Ransomes and Sims (2168), S. Rowsell (2174), W. Smith (2185), W. N. Nicholson (2158).

The common hand-rakes and hoes, although valuable implements in certain cases, have been found unequal to meet the requirements of modern farming, and machines have been constructed, by which the combined powers of several rakes or hoes, as the case may be, have been concentrated in one machine, to which motion is given by substituting horse for manual labour. The rakes are made either of wood and iron, or of iron alone, and consist of a series of curved tines or teeth working independently (so as to suit unequal surfaces), but attached to the same bar or frame, which is carried on two small wheels. The peculiar curved form of the tines enables them, when in motion, to ride on the surface of the soil, and thus collect any substances that may be lying loose on it, a simple lever arrangement giving the attendant who follows every facility for clearing them whenever necessary. The horse-hoes are more varied in form, some of them being intended merely for hoeing in between single rows or drills of beans or root-crops; others, again, being of a wider make, and intended more particularly for crops drilled at closer distances, such as wheat, &c. Of the horse-hoes for single drills we see several that deserve our attention, the increasing importance to the farmer of fallow crops having stimulated the different makers to vie with one another in providing him with the most efficacious implements for carrying out the great object of the system. We consequently have a large variety exhibited. They are mostly made of iron, in form resembling the handles and beams of a plough; the tines or hoes being fixed to the beam, and to the frame which is attached to it. A small wheel usually runs in front, by means of which the working depth may be regulated. In order to render them equally available in drills of different widths, they are constructed so as to expand more or less, as may be desired: this movement is effected in several different ways; the required width is obtained by shifting the tines or hoes along the frame in which they are fixed.

T. W. Ashby and Co., having made considerable alteration and improvement in their horse-rake, in its improved form, it may be regarded as one of the best and most easy-working rakes. The double-lever lifting handle, introduced last year, is found to be a decided advantage, and has been universally approved. By means of this arrangement the weight of the teeth is more equally distributed, and they can be more easily raised from the ground. This rake will also be found more simple in its construction, and so easily managed that a boy can work it. The teeth are entirely of steel, and set at such a curve as cannot fail to rake clean; they also fall quicker into work when lifted from the ground. This rake is lighter than most others, and at the same time it is one of the strongest rakes in use. It is longer, and has two more teeth than several other rakes at the same price. An important advantage also is the back bar of the frame being placed inside the teeth, instead of outside. By means of this bar the teeth are effectually cleared every time they are raised; thus no clogging can take place. The teeth being semi-angular, are decidedly preferable to the circular tooth rake, as they gather more lightly, leaving the winrow more exposed to the air and sun; thus the hay is more perfectly dried, and more quickly prepared for the stack.

Clay's Patent Horse-hoe.—The side knives of this hoe are attached to the handles and side frame-work, the handles can be moved, *during the progress of the horse*, either nearer to, or further from, each other; thus the width of cut may be *instantly* altered, and thereby adapt the implement to working between rows of irregular distances apart, without loss of time, and also avoid injuring any of the plants on either side, which it may be desirable not to cut up. The handles are held to their places by stops, which fit into a rack attached to the beam or central frame-work of the implement, the stops being worked by the attendant with his finger or thumb.

SOWING MACHINES AND DRILLS.

Exhibitors.—J. Begbie (2080), J. Coultas (2098), W. Hensman and Son (2126), Holmes and Son (2129), Hornsby and Son (2130), Priest and Woolnough (2165), R. and J. Reeves (2170), J. Smyth and Sons (2186), J. and T. Young (2237).

The earliest method of sowing seed was, without doubt, by dispersion from the hand, similar to the broad-cast of the present day. Of this practice mention is made in the Bible, as also in the works of several of the Roman agricultural writers, where we may also find several good practical directions as to the proper mode of effecting it. We have, however, good reasons for believing that, in some countries, the application of a machine for sowing grain was known at a very remote period. In China, Japan, and Arabia, records exist of such machines having been in use, from the earliest periods of their history. In our own country, so far back as 1638-53, Gabriel Platte ("Jewel House of Nature") describes a rude dibbling machine, formed of iron pins "made to play up and down, like virginal jacks." In 1647 we are told by Harte, that a regular drill machine was presented to the Court of Spain; and we find that Worledge, in his "Husbandry," published in 1669, not only advocated the use of the seed drill, but also of the drill for equally distributing manures. In 1730-40, Jethro Tull was devoting his energies to the introduction of his drill, in order that his system of horse-hoe cultivation might be fully carried out. His drills appear to have been more complicated than those which we make use of: they were constructed to sow two or more varieties of seeds at a time, depositing them at different depths; they also sowed manures, and had usually attached to them harrows for covering up the seed sown.

The drills exhibited merit special attention, as, by their satisfactory performance in the field, they have gained for their respective makers a high and well-merited reputation. In make, they are very much alike—their principal points of difference being in the spouts or shoots for delivering the seed, and in the arrangement of the steerage. The drills by Robert and John Reeves, by Coultas, and others, may be noticed, which are constructed to deposit seed, and also manure in a liquid form at the same time. This, for root-crops, turnips, wurtzel, &c., where a quick growth is desirable, is valuable, as it presents the manuring substance in a condition directly assimilable by the young plant—a matter of great importance at the particular season when such crops are usually sown.

The drop drill of Ransomes seems to occupy the intermediate place between the drill and the dibble, partaking of the characteristics of both operations. In appearance it resembles the drill, and consists of a frame carried on two large wheels, and having a certain number of curved solid skim-pressers, in place of the usual coulters. These work in the same manner as coulters, and are followed by the seed-depositors, which act independently of them, and by a simple motion adapt themselves to any inequalities in the land. The arrangement by which the seed is deposited in certain quantities and at certain intervals, is very ingenious, and well worth notice. These may be easily regulated with great nicety; and, by changing the cups, the machine will sow any description of seed.

Priest and Woolnough's hoes and drills are exceedingly useful implements. Holmes and Son maintain their high position in the manufacture of corn-seed and manure drills, and manure distributors. Double drill drop sowing-machine, for mangold wurtzel, beet, and turnip seed, or other seed of a similar nature, by J. and T. Young, of Ayr. This machine drops the seed in spots at regular distances apart, and is so constructed as to work effectually however unskilful the person may be who is attending it. Being made wholly of cast and malleable iron, it is not liable to be damaged by the weather or rough usage, and is easily drawn by a pony.

By using this machine a saving of one-half the seed is effected, and the plants can be thinned for 1*s.* 6*d.* to 2*s.* less per acre than if the common machine were used; besides the saving in seed and thinning; an important (perhaps the most important) point is, that by dropping the seed in spots, with blank spaces between, as is done by this machine,—if the young plants are allowed to stand longer than usual without being thinned,—they do not spindle and get weak as they invariably do if sown in a continuous line, as by the ordinary machines hitherto used. This machine is the only one which drops seed in spots at regular distances apart.

Smyth and Sons' patent drilling and sowing machines are of admirable construction.

The drills exhibited by Hornsby and Sons are professedly of a superior character. In most drills there is great imperfection in the most essential point, the conveyance of the corn or seed to the ground. The patent flexible india-rubber tubes remedy this defect, and supply a perfect conductor in the place of the tin cups in ordinary use, the delivery through which is irregular, especially in windy weather. The patent tubes constitute a great improvement in drills, simplifying and rendering them more efficient. The seed being delivered down one elastic tube, neither wind nor rain has the least effect upon it as it passes through the continuous tube with the greatest precision into the channel made by the coulter: all bouncing of the seed from one cup to another, which must be the case in drills where tins are used, is entirely done away with.

The general purpose drill is capable of drilling all descriptions of corn and seeds, with or without manure, in any required quantities, and at any distance apart. It is alike suitable to the various requirements of all farms.

The patent corn and seed drills are suitable to all methods of cultivation, will work upon any soil, and deposit corn and seeds at any distances apart. They are constructed with the improved slides, for regulating the quantity of seed at the pigeon holes; the feed of every coulter can, by these means, be increased or diminished without stopping the drill; also, with two coulter bars, to equalize the pressure upon each coulter.

Hensman's drill is no less useful. This implement is adapted to all kinds of grain and seeds, and may be used on any land, possessing this great advantage—that the corn-hopper is self-acting, and delivers the seed with as great regularity when traversing a hilly district, as when employed on a level plain. The delivery of seed is accurate, and easy of management; the coulters can be set to any distance apart; and the steerage is complete.

The seed drills exhibited by James Coultas may be briefly described as follows:—

They are—1st, a twelve row corn drill complete; 2nd, a twelve row small seed drill; 3rd, a nine row corn and manure drill; 4th, a three, four, five row root and manure drill; 5th, a perfect manure distributor.

Each division of labour may be most correctly performed, and with ease. The manures may be moist or dry and in any quantity.

REAPING AND MOWING MACHINES.

Exhibitors.—A. C. Bamlett (2076), G. Bell (2081), Burgess and Key (2086), J. Boyd (2084), R. Cuthbert and Co. (2104), W. Cranston (2099), W. Dray and Co. (2109), J. Ferrabee and Co. (2113), T. Green (2122), Kemp, Murray and Nicholson (2140), Kennan and Son (2141), J. Rowley (2173), Shanks and Son (2182), Ransomes and Sims (2168).

The manual delivery reaper, by A. C. Bamlett, appears to possess advantages which cannot be more satisfactorily given than by quoting the report of the judges of the Royal Agricultural Society at Leeds.

"This machine shows a manifest improvement. There are twenty guards with 2½ inch interval between each; the knife is plain, of triangular form, and strongly backed up and kept to its work by a massive iron attachment behind, which ensures great evenness and ease of cut. The cutter bar has 3 inches' throw, and the vibrations in every foot advanced are about six. As in the former instance, there are two wheels; but besides, there is introduced a useful wheel of small diameter immediately beneath the base of the shafts, which protects the knives from the furrow sides, and regulates their rise and fall. The mechanical contrivance for throwing the knife instantly out of gear is very good, as is the rachet motion for raising and lowering the platform, just beneath the rakeman. The platform is divided, the back part being attached by a hinge and suspended by an elastic band. Thus when the load overcomes a certain resistance opposed to it, it falls over at the back, and the labour of the man is materially diminished. A side delivery can be attached. Two horses in length are employed, two men, and one boy. The cut was regular and low: the bunches were straight, and well laid: the short ears were not more numerous than with other machines, though all were more or less culpable in this respect. The point of excellence most observable was the evident ease with which the horses drew the reaper in full cut 5 feet 3 inches."

Burgess and Key have on several occasions exhibited reaping machines since 1851. Since that time their machines have been made entirely self-acting, and now they both cut and deliver the corn; this is effected by a very ingenious screw delivery. Burgess and Key's reaping machine cuts a clear track of 5 feet 6 inches; and in every operation in which it was tested, exhibited a decided superiority. It cut with great precision both wheat and barley, standing and partially lodged; and in cutting through weeds and grass, showed no tendency to choke. The delivery is peculiar to this machine, and is the principal and most effective since last year; the corn, on being cut, falls on a series of rollers, fitted with Archimedean screws, by which it is delivered in a continous and well-formed swathe at the side of the machine. It will cut the heaviest and lightest crops lower and better than the scythe, by a novel and simple arrangement; both the wheels are geared, and they and the horses are placed so as to travel without passing over the cut grass. This is very important, particularly for clovers; the knife is hinged so as to follow the inequalities on the ground and fold up. The machine is then 5 feet wide. The height of cut is altered without altering the inclination of the fingers, and the machine can be readily backed any distance without throwing out of gear. For reaping grain Messrs. B. and K. have adopted their patent conical divider (as in their screw delivery reaper), which saves the raker one-third of the labour ordinarily required.

Ransome's Victoria reaper is exhibited in model. This machine is suitable for cutting any description of cereal crop, and delivering it at the side of the machine in neatly-formed sheaves. The automatic delivery is extremely simple, and capable of variation according to the weight of the crop. It consists of a series of rakes and arms which revolve round a vertical shaft under the guidance of an irregular waved ring or cam in such a manner that they bring the grain forward to the knives, and when cut deliver it at the side of the machine.

HORSE AND STEAM THRASHING-MACHINES.

Exhibitors.—**Barrett, Exall, and Andrewes (2078), Burgess and Key (2086), C. Burrell (2087), Clayton, Shuttleworth and Co. (2094), R. Cuthbert and Co. (2104), P. and H. Gibbons (2118), Holmes and Son (2129), Hornsby and Son (2130), Ransomes and Sims (2168), Robey and Co. (2172), Ruston, Proctor and Co. (2175), Tasker and Sons (2190), E. and F. Turner (2194), W. Underhill (2198), Wallis and Haslem (2199).**

The exhibitors of thrashing machines are numerous; a few only can be noticed.

Barrett, Exall, and Andrewes exhibit an 8 horse-power portable combined thrashing and finishing machine. It has the patent perforated beater drum, 54 inches wide, is made wholly of wrought iron, as is also the breasting. The straw-shakers are of wood, and the screens reciprocate with them, which prevents vibration. The bearings are the patent spherical ones which give absolute truth in setting the machine. It has the new patent corn elevator, which elevates any description of grain without the ordinary cups; dresses the corn while passing to the separating screen, by the use of which a second blower and the usual barley aveller are rendered unnecessary; the machine is greatly simplified, and bearings, pulleys, and straps are dispensed with, the wear and tear being greatly economized.

They also exhibit a patent horse-power portable thrashing-machine, constructed for three light horses. The drum and breasting are entirely of wrought-iron, the latter formed of separate bars with serrated faces, the ends of which pass through slots in the side of the machine, and are set nearer to, or carried farther from, the drum by means of two revolving plates, which have a continuous grooved worm cut on their faces, and which increases the space between each as it is set to or from the drum, and thus allows the larger corn room to escape. The gear-work is wholly enclosed in an iron cylinder, and by the arrangement of the wheels the strain is equalized, and the friction reduced, whilst all accidents are wholly prevented. It gives a speed of about 100 revolutions per minute, and will thrash all kinds of grain perfectly.

No. 2094, in addition to thrashing, winnowing, and dressing the corn, puts it into sacks for market. In No. 2131 the whole process of thrashing, shaking, elevating, blowing, and dressing the corn is performed by only one belt and without gearing. No. 2170 is intended for thrashing wheat, rye, barley, oats, and other grains, and dressing them for the market. To avoid the inconvenience of adjusting different screens for each kind of grain, a new patent screen has been invented which is readily adjusted for each sort of grain. Machine 2194 is worked by a 7 horse-power steam-engine, and thrashes from 30 to 40 qrs. per day. There is also a machine exhibited (2299) to suit those who prefer a machine which can be set down for work without being taken off the travelling wheels, which are merely let into the ground three or four inches.

The portable combined double-blower thrashing-machine, by Messrs. P. and H. P. Gibbons, is of the best construction, and in every respect efficient. It is calculated for all descriptions of grain, thrashing perfectly clean, and does not injure the seed. The straw, cavings, and chaff are each properly separated and delivered into their respective places; and the corn, after leaving the blower, is carried up by elevators into the barley horner and through a second blower, which takes out all the avels or horns, and greatly improves the sample.

Ransomes and Sims exhibit a combined double-blast thrashing-machine, intended for thrashing wheat, rye, barley, oats, and other grain, and dressing them ready for market. The drum is 54 inches clear width, and is fitted with patent reversible wrought-iron beaters, which do not break or injure the grain, and which will thrash barley so that it will malt perfectly. The grain is fed into the machine longitudinally, so that the straw is not bent in thrashing, and consequently it leaves the machine without being injured. After the corn has passed through the drum, the straw is carried into the patent shaker, in which part this machine radically differs from any other yet brought out. The objects to be obtained by a good shaker are threefold:—

1st. To separate the straw so that any grain remaining in it may be retained in the machine.

2nd. To carry back the grain and short straws thus separated to the dressing part of the machine.

3rd. To carry away the straw so that it may be easily removed from the tail of the machine.

The old reciprocating or crank shakers only accomplish the first and third of these requirements, and that at a great expense of power and wear and tear. To accomplish the second desideratum, additional apparatus is necessary, which generally consists of heavy reciprocating riddles set at an angle under the shaker, or some other equally cumbrous contrivance. The patent rotary shaker with which these machines are fitted, accomplishes the above three requirements in a perfectly satisfactory manner.

Tasker and Sons are exhibitors of a combined thrashing-machine, in which the strong feature is the arrangement of the straw-shakers. These possess all the advantages resulting from the use of two cranks; one only being used, the amount of tossing of the straw can be regulated as circumstances dictate. The short straws (or cavings) are separated from the corn and chaff by the vibrating riddles. The winnowing apparatus is fitted with one fan and suitable screens for dividing the corn from the chaff, and conducting the former to the patent corn elevator to be elevated into the separating screen.

The machine by Hornsby and Sons has been proved by the trials, by the Royal Agricultural Society, to answer its purposes thoroughly.

Garrett and Sons have a machine which has been brought out expressly for the purpose of suiting the special requirements of the colonial and foreign farmers; the travelling wheels are made extra broad and strong, fitted with iron axles, with hollowed boxes to carry the grease, especially adapted for travelling over rough roads or uncultivated ground, and properly proportioned to the power of the horses for effectually working the same. The wood-work is extra-seasoned by being specially dried, and will not be the least injured in the hottest climates, and the machine is constructed throughout with the view of economizing cost of freight by packing in the smallest possible compass.

There are many others; but, although excellent in character, they do not appear to present any special peculiarities.

SACK-LIFTERS AND ELEVATORS.

Exhibitors.—Amies and Barford (2071), J. Begbie (2080), W. Nicholson (2158), W. Underhill (2198).

These are arrangements by which the clean corn from the thrashing or winnowing machines is lifted into the sack or elsewhere without extra labour.

The grain elevator of Underhill is applicable for raising grain in mills, corn-stores, or unlading grain vessels, and will lift any quantity of grain in any required direction; and when applied to a thrashing machine acts as an elevator, barley-peeler, and smutter. The movement of the grain is effected by means of a fan. The blades are fixed on the winnowing shaft, and when in motion the grain is drawn in one direction and expelled in another.

MACHINE FOR HULLING OR DRAWING CLOVER AND TREFOIL SEED.

Exhibitors.—T. R. and R. Hunt.

MACHINES FOR CLEANING AND SEPARATING GRAIN.

Exhibitors.—R. Boby (2082), Childs and Owen (2092), Holmes and Son (2129), Hornsby and Sons (2130), T. and R. Hunt (2136), R. and J. Rankin (2167), Ransomes and Sims (2168), T. Scott (2182).

The machines for cleansing seed are of first-rate quality, and, of course, of many different kinds. The greater number are for corn and grain of the same description: there is one by Messrs. Hunt for hulling clover and trefoil seed. The merit of this machine consists in the great rapidity with which it performs its work without injury to the seed, and its drawing the two different kinds without any alteration. It will draw from 30 to 40 bushels of seed per diem with a four horse-power engine. The blower attached to the machine clears the seed of chaff and dust, effecting a great saving in labour. There is a machine for dressing carrot-seed, and also a grass-seed separator.

Ransomes' machine is fitted with a spiked roller. It will dress rough grain just as it comes from the thrashing machines which have no riddle or blower. By throwing off the strap lifting out the spiked roller, closing the toothed plate, through, which it works, with an iron cover, and changing the sieves, the machine is prepared for dressing grain as usually delivered from the single-blast steam thrashing machine. By setting the machine thus, and taking out all the sieves, it may be used as a blower or as a malt screen.

Ransomes and Sims exhibit also a self-cleaning and adjustable rotary screen. This machine will separate thin and light grain from a sample of barley, wheat, &c., making a perfect sample without leaving good grain with the tail. The distances between the wires can be altered, so that more or less light grain may be removed as desired, and the screen is therefore equally applicable to grain grown on different soils, or in different climates or seasons.

This screen is self-cleaning; it has no brushes either inside or outside, nor any washers or cleaners passing between the wires, and is therefore free from the objections to which screens so constructed are liable in wear.

HAYMAKING MACHINES.

Exhibitors.—Burgess and Key (2086), R. Boby (2082), T. W. Ashby and Co. (2072), J. and F. Howard (2131), W. Nicholson (2158).

There are several of these very useful machines exhibited. Ashby's haymaker has received numerous prizes from agricultural societies, both at home and abroad.

This machine has the double action as well as the reverse or backward motion. This motion is obtained in the most simple and easy manner, by means of a lever-spring handle attached to the near side drum-head of the machine, and without the slightest danger of accident to the attendant, who has perfect control over his machine both for reversing or for raising and lowering, without leaving the side of his horse.

This haymaker has been fifteen years before the public, and has been thoroughly tested on all kinds of grass land—hills, holes, grips, and all kinds of ordinary irregularity of surface being no impediment to its safe working. Among the prominent advantages of this well-known machine the following may be mentioned:—

The flange or main driving wheel of Smith and Ashby's haymaker is bolted on the flange of the road wheel, and in case of accident this can be easily and quickly replaced in the field at a trifling cost.

The wearing parts of this machine are few and simple, and readily replaced. Each tine bar rests upon two distinct sets of wrought-iron spoke-rings or bearers—the bars being thus firmly supported at both ends, are not liable to twist or break, and have double power and strength. Every tine bar is furnished with two strong well-tempered steel springs, thus enabling the machine to scatter the grass thoroughly without clogging: other machines have but one spring to each bar. The shifting apparatus is so simple, that the machine can be instantaneously reversed in its action, or thrown entirely out of gear, by the man in charge, without leaving the side of his horse.

The double-action haymaking machine of Boby should be mentioned, as it possesses most of the requirements of other machines in connection with its considerably lighter weight, consequently requiring less horse power; it is simple and easy of adjustment, and it is not liable to choke.

Nicholson's hay machine has the improvement of a wire screen for protecting the horse from hay in windy weather; the one exhibited, has the double and reverse action.

The principles of these machines, which may be described as revolving rakes, are too well known to require any especial description.

The haymaking machine of Barrett and Exall has two motions, a forward one for spreading the grass, and a backward one for lifting or turning it, when nearly made. It has a simple arrangement with instantaneous action for giving it the desired motion, as also for elevating or depressing the rake barrels.

This firm also exhibits a patent lever horse-rake, very strong, simple, cheap, unique, and novel. The outside frame used in all other rakes is dispensed with; the teeth are supported upon the axle, whilst a moveable cleaner works inside the teeth and descends as they rise. It has a simple adjustment for altering the depth of the teeth, while the rake is at work.

Belonging to this class are the lawn mowing machines: those with Kennans' registered *tilt action* delivery are ingenious; by these the cut grass can be easily transferred from the ordinary box in front of the cutters to a large receiver placed behind the metal rollers: this receiver can either be removed from the machine or overset when it is to be emptied.

CORN MILLS.

Exhibitors.—C. Burrell (2087), T. W. Ashby and Co. (2072), Barrett, Exall, and Andrewes (2078), Hunt and Pickering (2135), Garrett and Son (2117), Ransomes and Sims (2168), E. and F. Turner (2194), J. Tye (2196), Woods and Cocksedge (2207).

There are several examples of these very important machines. Barrett and Co.'s corn-grinding mill is fitted with 48-inch French burr stones, the upper one revolving, and an adjusting power is given so that it may be raised or lowered at pleasure. In Burrell's mill the whole is contained in a cylindrical iron frame. Hunt and Co.'s grinds and dresses the corn at one operation; this being carried on by means of two steel rollers which pass each other at different velocities. Ransomes' consists of a pair of French or English millstones mounted on a strong timber frame. Turner's mill has a large wheel or roller, 4 ft. diameter by 6 in. wide, working in contact with a smaller roller of equal width. Between the surfaces of these rollers the corn, &c., is crushed, pressure being applied to the small roller by means of a screw and spring. Tye has a fixed corn-grinding mill on a metal frame, with two pairs of French stones, 4 ft. diameter, and governors attached for regulating the stones when at work, which makes it easy to manage.

Garrett and Sons have a very useful machine. This mill is adapted for grinding every description of farm produce expeditiously and economically, and is fitted with an improved apparatus for adjusting the stones so as to grind to any degree of fineness required. An improved wrought-iron crane is sent with it, which is used for the purpose of raising the upper stone when required to do so for dressing.

CHAFF-CUTTERS.

Exhibitors.—T. W. Ashby and Co. (2072), Barrett, Exall, and Andrewes (2078), E. H. Bentall, (2079), C. Burrell (2087), Carson and Toone (2090), J. Cornes (2097), E. Page and Co. (2161), Richmond and Chandler (2171), Burgess and Key (2086).

Chaff-cutters are exhibited in great variety by different makers, some of which are intended for hand-work, and others for horse or steam-power. In most cases the cutting knives are attached to the fly-wheel, varying in number, from one to three: the outward curved, or scimetar knife, is that most approved of, as dividing the straw by a drawing-cut, instead of the pressing-cut, of the knife curved inwards. The chaff-cutters exhibited appear likely to meet the requirements of the farmer. They all have arrangements for cutting chaff of different lengths—a matter of importance where the chaff is required for horses as well as for ruminating animals; they also enable the farmer to economize his straw by cutting it up for litter, instead of throwing it down whole. The liquid secretions are thus more readily absorbed, the animals kept cleaner and drier, and the manure far better made.

There are several different arrangements of the cutting-knives. Some have two edges, and are fixed in a frame which is moved up and down (vertically) on the face of the machine, by means of a crank worked by a handle and a fly-wheel; they cut with each motion.

In others, the cutting-knives have serrated (saw-shaped) edges, which are kept true by a very simple and efficient method of sharpening. For cutting broken or damp straw or hay they are very good, as the rough edges of the knives insure a readier hold on the substance presented to them.

In all cases it is desirable that the knives should be so arranged as to effect a continuous cut, in order that the resistance may be kept equal. In cases where one knife finishes before the other begins its cut, the rotatory motion is increased during the interval by the absence of resistance: this being again checked occasions a lateral vibratory action, more or less according to the speed at which it is driven.

Of the chaff-cutters exhibited, Andrewes's should be noticed, as the frame-work is iron, and is adapted for manual, horse, or steam power.

Richmond and Chandler show a superior implement; it is fitted with toothed rollers, rising mouths, stop motion, and a patent steel mouth-piece.

Barrett and Exall are exhibitors of chaff-cutters representing a new and much improved series. The frames are of iron. The arrangement is simple, but very strong and effective, the working parts are protected, and they are adapted for manual, horse, and steam power. The same firm have a well-devised patent gear-work, adapted for working a chaff-cutter by one-horse power, with or without an intermediate motion. By using the latter, the speed is increased two to one.

OIL-CAKE MILLS.

***Exhibitors.*—E. H. Bentall (2079), Hunt and Pickering (2135), W. Nicholson (2158), Barrett and Co. (2078).**

Machines for crushing oil-cake, corn, beans, and linseed, are now in general use in most farm establishments. There are some excellent ones for either purpose exhibited. Those for oil-cake require great strength, and are usually made with two parallel rollers, armed with spikes or teeth of a pyramidal (cams) or curved form, fixed in a strong frame, set in motion by means of cogged wheels and a fly or driving-wheel, to which the handle is attached. The distance between the rollers can be regulated so that the cake may be crushed either for sheep or cattle.

The crushers for grain and linseed are somewhat different, the rollers being either fluted or quite plain; for beans they are generally fluted. They vary in form, and also in the method of regulating the rollers. In some, also, we find only *one roller* working against either one or two fixed plates in front or behind, which are grooved or fluted like the roller. The advantages resulting from the use of these machines, in the preparation of artificial food for cattle, are of great importance, as not only does the food afford greater nourishment, owing to its divided state and more assimilable condition, but the crushed state of the grain prevents germination, should any of it become mixed with the litter either by accident or by the excretions of the non-ruminating animals, which is too often seen when the whole grain is used.

Barrett and Exall's oil-cake mill has two sets of teeth, revolving toward each other, so shaped as to take a firm grip of the cake, and break it small or large, as may be desired.

Grain mills are also exhibited by Barrett and Exall, for crushing and splitting corn for horses and cattle. They will crush oats, barley, and linseed, and split beans and peas, with a minimum expenditure of power; and are adapted for hand, horse, or steam power.

To this may be added, the gorse machine, which first cuts up the gorse like fine chaff, and then crushes it between rollers, running at different speeds. The prickles are completely destroyed, and the gorse reduced to a pulp fit for cattle food.

In the oil-cake mill by Nicholson, the method of driving the breaking-rollers to vary the sizes broken is very simple and effective; the frames are of wrought iron, and are made either with one or two pairs of crushing rollers, according to the purpose for which they are required.

AGRICULTURAL CARTS.

Exhibitors.—W. Ball (2075), The Busby Implement Co. (2088), A. and E. Crosskill (2102), A. and T. Fry (2116), Milford and Son (2154).

The above persons exhibit some very useful and well-made carts and waggons of various descriptions, and for every variety of purpose.

HORSE GEAR.

Exhibitors.—**T. W. Ashby and Co. (2072), Bentall (2079), Carson and Toone (2090), Woods and Cocksedge (2206), &c., &c.**

The above are exhibitors of horse gears: the latter (2206) should be mentioned as being probably the newest; it is of iron, and can be fixed so as to drive a chaff-engine, root-pulper, and crushing and grinding mill.

Barrett and Exall are exhibitors of a 6 horse-power patent gear. The whole of the machinery self-contained in an iron cylinder, and adapted for communicating power for thrashing, sawing, pumping, &c.

TROUGHS AND FOOD MACHINERY.

Exhibitors.—**Barnard, Bishop, and Barnards (2077), T. Scott (2179), B. Samuelson (2178), Richmond and Chandler (2171), Carson and Toone (2090).**

No. 2077 is a trough for pigs. 2179 for cattle and sheep. 2187 is a machine for cutting turnips for cattle. Carson and Toone exhibit a machine of the same kind.

Biddell's patent bean cutter, exhibited by Ransomes and Sims for splitting hard or soft beans, peas, and Indian corn, is a good machine.

It is well known that neither solid-roller mills nor millstones will split beans unless they are in good condition, on account of their sticky nature when damp. A stone or other foreign substance passing into a solid-roller mill generally damages the rollers, which are costly and difficult to repair. In Biddell's patent bean cutter these defects are entirely remedied. The barrel or cutting roller is hollow, and is formed by a number of separate triangular steel cutters, arranged around the circumference of two end rings, and so set that there is more clearance at their back than at the cutting edge, therefore the mill can never choke, no matter what may be the size or condition of the beans. Each tooth has three separate cutting edges, which can be successively used, and when all are worn out they may be easily replaced with new teeth by an ordinary labourer. The amount to which the beans are crushed is governed by a screw.

They are also well adapted for cracking peas or Indian corn, and have been successfully applied over a pair of stones for cracking the Indian corn before grinding.

GARDEN ROLLERS.

There are some varieties of these, the most novel being Amies and Barford's water ballasting adjustable garden roller. It is formed of an enclosed wrought iron cylinder, and being made perfectly water-tight, can be weighted at pleasure. It is provided with a solid brass water plug, fixed firmly into the surface of the cylinder, which can be removed by a square key, made for the purpose, and the roller filled with water in a few minutes. No remark as to this simple method of securing additional weight is necessary.

HORTICULTURAL HOUSES AND IMPLEMENTS.

Exhibitors.—T. Dennis (2105), J. Dore (2106), J. Ferrabee and Co. (2113), J. Gray (2119), Hayward Tyler, and Co. (2197), Hereman (2127), T. Kay (2139), C. Lee (2144), Lipscombe and Co. (2146), H. Morton and Co. (2154), W. Nixey (2159), H. Ormson (2160), R. Read (2169), St. Pancras Ironwork Co. (2176), G. Smith (2185), J. Stanley and Co. (2188), J. Taylor and Sons (2191), Warner and Sons (2200), J. Weeks and Co. (2201), R. Willison (2204), R. Read (2196), St. Pancras Ironwork Co. (2176).

The metallic houses of T. Dennis are constructed entirely of iron; and by the introduction of malleable fittings, each part is brought together with such facility as to overcome the only obstacle hitherto existing.

The cost of these structures is moderate, whilst in increased strength and durability, shadowless frames, and their capabilities as to form, their advantages are obvious. They can be erected by an ordinary mechanic in a few hours (screws or bolts being entirely dispensed with).

Their extreme portability is of advantage; and however long they may have been fixed their removal and re-erection can be accomplished without injury to any of the framing.

Their extension can be accomplished without alteration to any existing structure. Every front light can be made to open, and swings upon the mullion without hinges: while roof ventilation has no limits. The condensed water from the roof is carried outside the building, thereby preventing the decay which follows when it is allowed to accumulate upon the eaves plate.

Every one is now supposed to be aware that glazed iron roofs, judiciously arranged, have not the least tendency to break the glass. And for those who have still this erroneous impression, the patentee explains that the most evident causes of fracture arise either from the glazier extending the laps of the glass so far upon the preceding square, that in cold weather ice is formed to such an extent (from the quantity of moisture necessarily retained) as to break the glass by its expansion; or from the bars of which it is composed being so irregularly spaced that the glazier is often compelled to introduce the glass with the bars on either side pressing tight against it—thus causing fracture; whilst other panes necessarily fall short of the width, and certain leakage is the result. These well-known evils are said to be overcome by the application of distance pieces between the bars, by which each glass space is rendered equidistant from top to bottom, and throughout any extent of surface, insuring a water-tight and perfect roof.

Samuel Hereman exhibits portable and economic hot-houses from the designs of Sir Joseph Paxton. These buildings are made of the best seasoned red deal, are well fitted together, and glazed with 16-oz. glass. They are composed of simple parts, and can be fixed, enlarged, removed, and adapted to every horticultural purpose by ordinary labourers. They are calculated for gardens of the highest order—for gentlemen's gardens generally, for market gardens, where they may be made to cover any extent of surface, and also for suburban, villa, and cottage gardens. Their moderate cost not only places within the reach of persons of limited means a luxury hitherto confined to the wealthy, but offers immense advantages to all who have garden walls already standing; as from their peculiar construction they can be formed into ranges of lean-to houses with facility, and at small cost. Whilst they are adapted for permanent structures, they are also particularly suited for persons having temporary or limited tenures, as they can with ease be packed up and removed at the expiration of the tenancy.

In the Open Court—between the Agricultural Class, and the division of the Annex devoted to vegetable and animal substances used in manufactures—the conservatories and other houses are placed; they can therefore be carefully examined.

Garden engines, syringes, pumps, water barrows—in fact, everything necessary for watering gardens—are exhibited in great variety.

Boilers and heating apparatus of various kinds are here. In the former the object aimed at, and in many cases approached, has been the production of steam by the smallest possible consumption of fuel. To obtain this end, the largest quantity of surface is exposed to the action of the fire; this being usually effected by a system of tubes, through which the water circulates, while the flame plays around them.

In the heating apparatus the object is to obtain a large amount of radiating surface, so that the fluid passing through the tubes may diffuse its heat with the least interruption.

APPARATUS FOR BLASTING ROOTS AND STUMPS OF TREES.

Exhibitors.—Kennan and Sons (2141).

The powder being placed in a hole bored about two-thirds across the root (diagonally to the grain of the timber), the perforated iron screw plug is firmly screwed into the top of the hole, a piece of safety fuse being passed down through the centre hole in the screw plug. The largest root may be broken up with a few ounces of gunpowder without any danger.

SPIRIT DRAINING LEVELS.

Exhibitors.—E. Weir (2202), H. A. Thompson (2193).

Weir's is an exceedingly simple and cheap instrument, giving the rise or fall of land for drainage, road-making, &c., at once on a quadrant-plate without any computation, so that any agricultural labourer who can read, can use it.

Thompson exhibits drainage levels: amongst others is a workman's pendulum level for accurately digging the drain to the fall found by other instruments. This level is of the same description as the ordinary bricklayer's, but instead of a plumb-bob has a pendulum pointer, which gives the inclination of the bottom bar on a brass plate at the top of the instrument, where it can be seen, which the plumb-bob cannot be, at the bottom of the drain.

WESTON'S NEW PATENT DIFFERENTIAL PULLEY BLOCKS.

These are exhibited by Amies and Barford (2071) with their agricultural apparatus. The peculiar merit attached to these pulleys is that whilst they are more powerful than ordinary pulley blocks, they also possess the novel and invaluable quality of not "running down," under any circumstances, whilst the load is suspended to them.

The action of these pulleys may be thus explained:—The upper block has a double sheaf of two different diameters, with teeth gearing into the endless chain which hangs from it in two loops, in either of which is placed the single block having a hook for attaching the weight to be hoisted. If the toothed sheaves of the upper block were of equal diameters, the weight would remain stationary, whilst the endless chain was passing over them, owing to the same length of chain being drawn up on one side as was being pulled down on the other side; but as one sheaf is larger than the other, and as both sheaves, being fastened together (or made in one piece), work together, the large sheaf takes up more chain than the small sheaf does, consequently the weight is raised proportionally. The purchase is about 22 to 1—that is to say, when 22 links of chain pass over the large sheaf, the weight is lifted the length of one link.

Each set has two speeds; a fast one—by pulling the chain—for light lifts and for running the tackle up or down to any desired point; and another—by using the lever—which gives a lifting power equal to an ordinary crab and blocks combined.

Lifting and lowering are effected by pulling opposite sides of the loops, either the slack one or that which bears the weight; or for the heavier weights when using the lever, the motion is reversed by turning it over to work in an opposite direction.

A weight hung to the single block, in either loop, does not run back, even if the chain is suddenly let go, because the opposite sides of the loop pull against each other on opposite sides of the double sheaf.

CHURNS AND DAIRY IMPLEMENTS.

Exhibitors.—**Burgess and Hey (2086), Carson and Toone (2090), E. Ferryman (2114), J. and F. Hancock and Co. (2124), H. Hunter (2137), E. Weir (2202).**

The first exhibits a patent American churn; the second cheese presses. Hancock and Co. have a butter machine, which separates the acid and milk from butter without touching it with the hand, cooling it at the same time. Hunter's is a churn professing to have the latest improvements, and as such merits some notice; and the last is a patent box-churn which is described as being able to make a large quantity of butter in a shorter time than any other.

GATES, WIRE NETTING, FENCING, &c.

Exhibitors.—**Bain, McNicol, and Young (2074), Barnard, Bishop, and Barnards (2077), Dray, Taylor, and Co. (2108), J. Haywood (2125), Hill and Smith (2128), Kennan and Son (2141), C. Moody (2153), Musgrave Bros. (2156), S. Rowsell (2174), H. Thompson (2193), W. Underhill (2198).**

A garden-gate, composed of malleable and cast iron, in which are introduced slabs of marble to carry out the ornamentation, is exhibited by Bain and Co; also an ornamental railing in the same style to correspond with it. The same firm exhibits a rabbit and hare proof wire netting, for gardens, of galvanized iron, and an elegant wire flower-stand. Some wire netting galvanized in the piece is also exhibited by Barnard and Co., who also send several varieties of garden and park chairs. Thompson's entrance gates, made of iron and wood; the latter forming a trussed framing which is tied by the former; the mountings, being a combination of levers, are strong and useful. Ornamental garden chairs and vases of cast iron. Fence standards (2141), made of a single piece of iron rolled should be noticed; iron angle plates are riveted about 12 inches from one end, which is fixed in the earth without stone or wood blocks. Kennan and Son have a tangential winder, for tightening iron fences; it has a coarse iron screw working into teeth upon the circumference of a barrel upon which the wire is coiled, so that by turning the screw the wire may be strained to any extent and cannot be accidentally relaxed. Musgrave Brothers are the only exhibitors of iron stalls for cattle.

MISCELLANEOUS AGRICULTURAL IMPLEMENTS.

Amongst the miscellaneous articles may be enumerated the following:—

Patent box churn, which makes a larger quantity of butter in a shorter time than any other.

A machine capable of weighing 300 lbs., and being carried in the pocket.

In addition to those which have already been mentioned, as contributed by the trustees of W. Crosskill (2101), is a bone mill. A. and E. Crosskill have some machine-made wheels and axles; P. Drummond (2110) has a land-cleanser which, without hand-labour, gathers, lifts, and carts stones, felt, corn, &c. A circular sheep crib is sent by J. Eaton (2111). Some draining tools, are exhibited by Messrs. Mapplebeck and Lowe (2149).

J. Woodbourne exhibits an improved machine for packing hops (2205).

There are a few pumps exhibited respectively by R. Boby (2082), J. James (2188), B. Leslie (2145), E. Weir (2202), R. Willison (2204.) The first is a wort pump for brewers; the second may be used for liquid manure, irrigation, or any similar purpose; the next is a model of a pump constructed purposely for irrigation in India, and is worked by wind; the next exhibits a pump for garden, and fire-engines with two cylinders, double handles, and four wheels; Willison exhibits a new lift and force-pump.

The *Log-Sawing Machine*, exhibited by Kennan (2141), is worked by one man, and the saw-frame is hung on jointed bars, fitted with box-springs which materially assist the back stroke, and takes all strain off the wrist. The blocks to be cut are secured by an iron cramp, and short pieces are supported by a movable rest. Ashby and Co. (2073), and also Wilkinson, Wright and Co. (2203), exhibit saw tables.

Amies and Barford (2071) exhibit a portable steaming apparatus; and it is in general use for steaming food for cattle, also for domestic purposes when required for large quantities, as in gaols, asylums, &c.

BEE-HIVES.

Exhibitors.—**J. Boothman (2083), R. Downie (2107), R. Fenn (2112), H. Hughes (2133), S. Kingston (2142), E. Lovey (2147), J. Marriott (2150), Major Munn (2155), G. Neighbour and Son (2157), G. Phillips (2163), W. Tegetmeier (2192).**

The management of bees interests a large number of persons. The economy of bees has ever been a matter of curious interest. In the hives exhibited, and especially in those holding the living working bees, many novel arrangements will be seen. Accounts have been furnished by the exhibitors; but they are far too much in detail, for the space which can be given to the subject. The inquiring visitor will, however, find in the bee-hive group near to the conservatories, much that will well repay a careful inspection.

Class V.—Railway Plant, including Locomotive Engines and Carriages.

Number of Exhibitors, 85.

Class VII.—Manufacturing Machines and Tools.

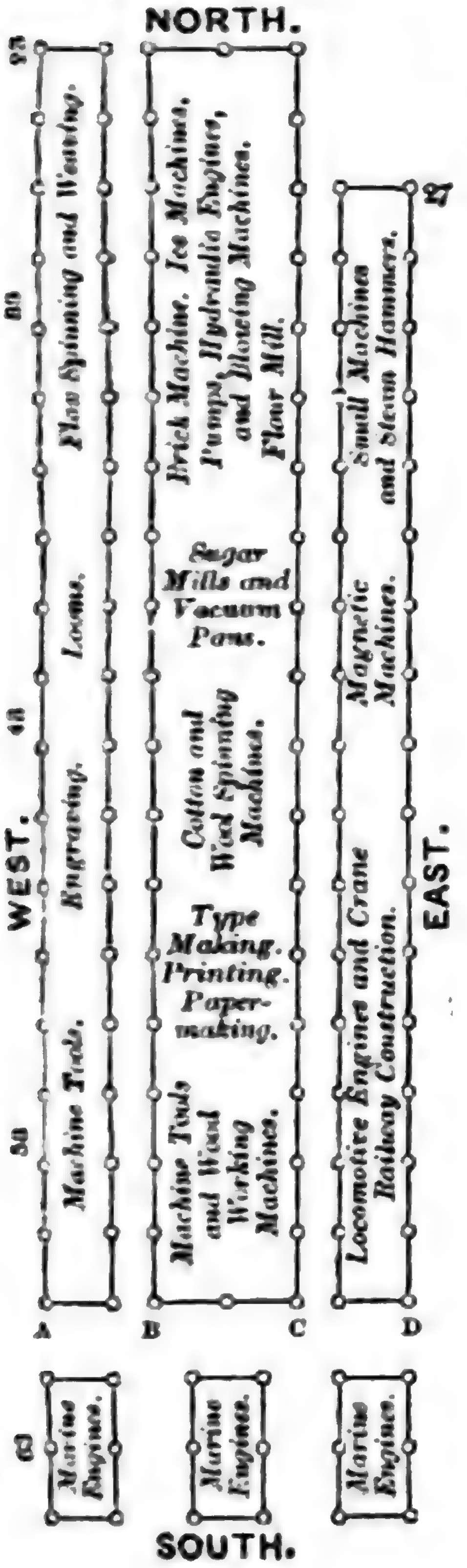
Number of Exhibitors, 257.

Class VIII.—Machinery in General.

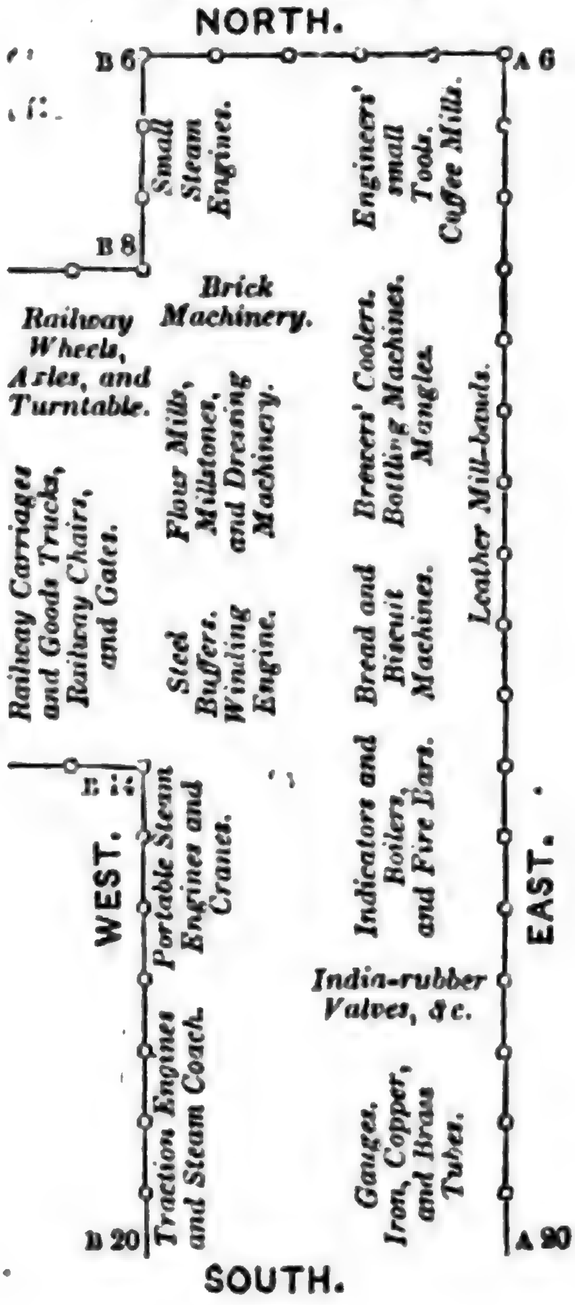
Number of Exhibitors, 255.

Situation of Classes.—*The Western Annex, and the Northern end of the Eastern Annex.*

Western Annex.


NORTH.
93
80
48
30
63
WEST.
EAST.
27
Flax Spinning and Weaving.
Looms.
Engraving.
Machine Tools.
Brick Machine. Ice Machines. Pumps, Hydraulic Engines, and Blowing Machines. Flour Mill.
Sugar Mills and Vacuum Pans.
Cotton and Wool Spinning Machines.
Type Making. Printing. Paper-making.
Machine Tools and Wood Working Machines.
Small Machines and Steam Hammers.
Magnetic Machines.
Locomotive Engines and Crane Railway Construction.
A
B
C
D
Marine Engines.
Marine Engines.
Marine Engines.
SOUTH.

Eastern Annex.


NORTH.
B 6
A 6
Small Steam Engines.
Engineers' small Tools. Coffee Mills.
B 8
Brick Machinery.
Railway Wheels, Axles, and Turntable.
Flour Mills, Millstones, and Dressing Machinery.
Brewers' Coolers. Bottling Machines. Mangles.
Leather Mill-bands.
Railway Carriages and Goods Trucks, Railway Chairs, and Gates.
Steel Buffers. Winding Engine.
Bread and Biscuit Machines.
B 14
WEST.
Portable Steam Engines and Cranes.
Indicators and Boilers, and Fire Bars.
EAST.
India-rubber Valves, &c.
Traction Engines and Steam Coach.
Gauges, Iron, Copper, and Brass Tubes.
B 20
A 20
SOUTH.

The various articles in Classes V., VII., and VIII., are placed in the Annexes, the southern part of the Western, and the northern part of the Eastern one, being filled by them. The arrangement is not according to the number of the Catalogue, but all the machines in motion, requiring steam-power, and all heavy tools and marine engines, are to be found on the western side; the eastern side receiving some of the smaller machines, not at work; without respect to the classification.

The space occupied by the different classes of machines in the British portion of the Western Annex is indicated in the plan on page 221; the line of figures along the edges marks the number of the pillar of every tenth bay, each of the letters, A, B, C, D, corresponding to one of the distinguishing letters of the four parallel rows of columns.

The plan of the Eastern Annex is on a larger scale, as, on account of the miscellaneous nature of its contents, more space is required to insert the names of the groups; it is divided by reference to the numbers of pillars, as in the former case.

There are three other localities in which small portions of these classes are accommodated; they are, the carriage department, under the English picture galleries; the Process Court, near the jewelry and porcelain departments, and the large Open Court, between the raw material and agricultural implement galleries.

For the purpose of a rapid survey of the principal objects contained in the above classes, it will be convenient to adopt an arrangement after the following order. The groups are—

Locomotive Engines and Railway Carriages, **W.** and **E. A.**[*]
Railway Construction, **W.** and **E. A.**
Traction Engines for Roads, **E. A.**
Boilers, **E. A.**

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[*] **W. A.** signifies Western Annex.
E. A. „ Eastern Annex.
P. C. „ Process Court.

Stationary Engines, **W.** and **E. A.**
Marine Engines, **W. A.**
Driving-belts and gearing, **W.** and **E. A.**
Machine Tools, **W. A.**
Steam Hammers, **W. A.**
Wood-working Machinery, **W. A.**
Spinning Machines, **W. A.**
Weaving Machines, **W. A.**
Sewing Machines, **P. C.**
Blocks for shawl-printing, &c., **W. A.** and **P. C.**
Paper Machines, **W. A.**
Type-founding Machines, **W. A.**
Type-composing Machines, **W. A.** and **P. C.**
Printing Machines, **W. A.** and **P. C.**
Brick-making Machines, **W.** and **E. A.**
Hydraulic Machinery, **W. A.**
Sugar Mills, **W. A.**
Oil Mills, **W. A.**
Flour Mills, **W.** and **E. A.**
Bread and Biscuit-making Machinery, **E. A.**
Machines for lifting Weights, **W.** and **E. A.**
Machines employing Magnets, **W. A.**
Brewing Machinery, **E. A.**
Distilling Apparatus for Sea Water, **E. A.**
Automaton Balance, **W. A.**
Sundries, **E.** and **W. A.**

The precedence assigned to marine and locomotive engines is owing to the fact of their occupying the most prominent positions, and forming compact groups near to the entrance of the Western Annex. The remaining articles follow a nearly natural order, which in most cases will be found to correspond generally with their positions among the machines in motion. If the classified and numbered lists of exhibitors' names be examined in relation to the above arrangement and its distinguishing letters, it will be immediately seen whether the objects are to be found in the Eastern or Western Annexes, the Process Court, the Carriage Department, or the Agricultural Class.

LOCOMOTIVE ENGINES FOR RAILWAYS.

Exhibitors.—**Sir W. G. Armstrong and Co. (1230), Beyer, Peacock and Co. (1238), G. England and Co. (1250), W. Fairbairn and Sons (1251), Lilleshall Co. (1266), London and North Western Railway (1269), Manning, Wardle and Co. (1274), Neath Abbey Iron Co. (1278), Neilson and Co. (1280), Robert Sinclair (1316), Sharp, Stewart and Co. (1299).**

There are eleven exhibitors of this class of machinery, illustrating the various modifications adopted for different kinds of traffic; of these six are engines for passenger traffic, and the remaining five for colliery and goods engines.

Sir W. Armstrong's engine is constructed for India. The width of the gauge between the wheel is 5 feet 6½ inches; all the mechanism, excepting the eccentrics and other valve gear, is placed outside the frame; the cylinders are slightly inclined forward, the feed pumps are attached to the cross-head of the steam piston. There are two pairs of coupled driving wheels 5ft. 6in. high; a light iron framing supports an awning to shelter the driver and stoker from exposure to the sun.

The large express engines, with 7ft. 6in. driving wheels, in use on the southern division of the London and North Western Railway, was built at Wolverton, on M'Connell's patent plan, the fire-box being very much larger, and the relative proportion between fire-box and tube surface, different from that adopted in the ordinary style of construction. There are neither feed-pumps nor donkey-engine, the boiler being fed by Giffard's patent injector.

A second express engine is contributed by the London and North Western Railway Company; it is mounted on six wheels, the centre driving pair being 7 ft. 8 in. high, it was constructed at the company's factory at Crewe, by Mr. Ramsbottom. The tender of this engine is provided with an apparatus for replenishing the supply of water while the train is in motion; this is effected by a curved tube of rectangular section, which is capable of being lowered so as to dip into a trough of water placed between the rails; the impulse imparted to the water by the velocity of the train causes it to rise in the tube and flow into the tender tank. A large working model is added to illustrate the action of this contrivance.

In actual practice, the troughs are used in lengths of a quarter of a mile, and a speed greater than 15 miles per hour is requisite, in order to make the scoop act; at 22 miles an hour 1080 gallons can be picked up out of one trough, and 1180 gallons at 35 miles an hour, at which speed the maximum effect is produced. Taking the above maximum quantity as a basis for calculation, namely, 1180 gallons lifted through a height of about 7½ feet, it will be found that the power required is from six to seven effective H.P., employed for a period of 1¾ minutes.

The outside cylinder, express engine, constructed for the Caledonian Railway Company by Messrs. Neilson and Co., is similar, in general appearance to the last; the driving wheels are 8 feet high.

Messrs. Beyer, Peacock and Co.'s locomotive is intended for a Portuguese railway of the gauge of 5ft. 6in.; it has six wheels, the centre pair being 7 feet high; the cylinders and all the driving mechanism are placed inside the frame, under the boiler; the fire-box is fitted with sliding furnace doors.

Sharp, Stewart and Co. exhibit an engine for goods trains; having the fire-box and grate specially adapted for burning coal; there are three pairs of wheels, all of equal height and coupled together; a capacious roof is fixed over the driver's platform, in a manner similar to that employed on the American railways.

Manning, Wardle and Co. send a small four-wheeled tank engine, for the use of colliery lines; it has two pairs of low wheels, 2 ft. 9 in. in diameter, all of which are coupled together. It has been constantly employed, since its arrival at the beginning of April, in dragging the heavy boxes of machinery to their appointed places. Giffard's injectors are used instead of feed pumps.

RAILWAY CARRIAGES.

Exhibitors.—**J. Wright and Sons (1310), R. Restell (1293), J. Ashbury (1231), Gloucester Waggon Co. (1254), Harrison and Camm (1257).**

A small number of passenger carriages, and goods waggons, are placed near the north end of the Eastern Annex, including a first-class carriage for the Egyptian railway, painted white, and furnished with a second roof in order to protect the top of the carriage from the direct rays of the sun. A saloon carriage is sent by J. Ashbury, of Manchester.

The goods waggons shown are—a wooden coal truck by Harrison and Co., of Masboro', an iron coal truck with cast steel tyres and axles, by the Gloucester Waggon Company, and a closed goods waggon by J. Ashbury, of Manchester, which was built in eleven hours twenty minutes from raw materials (pig iron and timber), in exactly the same state as those which are now placed beside it.

Mr. Fay's system of continuous breaks in use on several of the English railways, is illustrated by a model. All the breaks in one train are worked simultaneously from one handle, by endless screws mounted on axes placed underneath the carriages: the coupling of these axes is effected by universal link joints; the break blocks are mounted on slides so as to work in a straight line, instead of moving on a hinge joint, causing them to wear away equally, so as not to require readjustment.

Mr. James Newall's plan differs from the above, in the use of a rack and pinion motion, instead of a screw and worm wheel, for working the breaks.

An interesting collection exhibited by Mr. H. Hughes, of models of the various kinds of carts, earth waggons, &c., used by contractors, in the construction of railways, is placed in the upper part of the Eastern Annex.

MATERIALS USED IN RAILWAY CONSTRUCTION.

Exhibitors.—**W. B. Adams (1227), Anderston Foundry Co. (1229), R. Aytoun (1232), Bain, McNicol, and Young (1233), W.**

Baines and Co. (1234), G. A. Biddell (1239), Butterley Iron Co. (1241), H. L. Corlett (1244), G. E. Dering (1246), Dixon and Clayton (1247), T. Edington and Sons (1249), Governor and Co. of Copper Mines in England (1255), W. F. Henson (1259) Isca Foundry Co. (1262), C. Little (1267), London and North Western Railway (1271), E. Morris (1275), J. Murphy (1277), J. Newall (1283), Ordish and Le Feuvre (1284), P. M. Parsons (1286), Permanent Way Co. (1288), Ransomes and Sims (1291), G. Richardson and C. Chattaway (1294), R. Richardson (1295), W. Seaton (1298), W. Simons and Co. (1300), W. L. Tizard (1304), T. S. Truss (1305), A. Vickers (1306), Weston and Grice (1308), F. Wise (1309), P. Wright (1311), T. Wright (1312).

The various forms of rails, and other permanent-way materials, are mostly arranged in a line parallel with the row of locomotive engines; a smaller portion is in the upper or northern end of the Eastern Annexe. The general tendency of the recent alterations made in these articles, is to substitute iron for wood as much as possible; thus we have chairs with iron keys, or with the wooden keys reduced to a minimum, chairs with a basin, or disc, shaped foot, to rest on the road without the intervention of wooden sleepers, &c.

T. Wright and Co.'s systems of permanent-way construction, employing no other material than iron, are seen in different models, exhibiting the completed designs, and proposed methods for their gradual introduction on railways, now employing the ordinary wooden sleepers. Their project for a safety railway consists, in providing the outer side of the rail with a vertical flanged iron kerb, three inches high; a safety catch fixed on the carriage is intended to afford support by falling on to the top of the kerb, in the case of an axle breaking, or a similar catch being made adjustable by a pressure screw, would form a powerful break.

A method of fish-jointing rails with plain bolts and keys, instead of the ordinary screw bolt, is used by the Taff Vale Railway Company, and shown in the Eastern Annex.

Mr. Henry Corlett's continuous surface rail, formed entirely of wrought iron, and dispensing with timber sleepers, chairs,

Digitized

and fishing-plates, is laid down in the Western Annex, in the line, on which the three northernmost locomotives stand.

A plan for dispensing with the ordinary fishing-plate in joining rails, by Mr. G. Dering, proposes the substitution of a spring steel clip, similar in principle to the common spring letter-holder, embracing, in rails of a double-headed section, the lower web, and the body of the rail.

The same exhibitor has a pair of rail joints, formed by brazing the ends of the two bars together. These have been used on the Great Northern Railway for four years, without perceptible deterioration: other specimens which have been tested by repeated blows with sledge hammers, illustrate the great strength of this method of fastening.

A system of continuous timber bearings for railways, by Mr. Wm. Seaton, combines solidity with economy of wood; the cross-section of the longitudinal bearing is a right-angled triangle, the hypotheneuse forms the lower surface, the apex of the right angle supports the rail, which differs from the ordinary bridge rail, in having inclined side webs or flanges instead of flat ones. The longitudinal bearings are united by transverse sleepers, also of triangular section.

Mr. Ramsbottom's chair, used by the London and North Western Railway Company, is made entirely of wrought iron; the rail is held by the middle so as to prevent the lower head being deformed by pressure against the bottom of the chair; wrought iron keys are used instead of wooden ones.

Specimens of rails, wheels, tyres, and axles are dispersed over the Building; the greater number are exhibited in Class I. as specimens of iron manufacture.

The principal exhibitors of railway weighing-machines are Messrs. H. Pooley and Sons, and Mr. R. Kitchin, each of whom furnishes a many-tabled machine for weighing locomotives; this is done, to ascertain the proportion of the load borne by each axle, for the purpose of adjusting the springs. Messrs Beyer, Peacock, and Co.'s express engine, weighing between 27 and 28 tons in its present condition, is placed on Mr. R. Kitchin's tables.

Railway signals are principally illustrated by models of various self-acting arrangements for tunnels, &c., most of which are furnished with very full accounts of their construction; full-sized examples of station semaphores, by Messrs. Stevens and Son, entirely constructed of open wrought-iron work, are among the most prominent objects in the Western Annex.

A working model of a plan for simultaneously opening or closing the gates, protecting a level crossing of a road, over a railway, is exhibited by Mr. Archibald Vickers; this is effected by two parallel shafts, each carrying a right and left handed screw thread, which are worked by appropriate gearing, from one handle.

Turntables and traversers for turning and removing railway carriages from one line of rails to another, are principally to be found in the Eastern Annex; among them is a turntable mounted on a ring of spherical bearings instead of having a central pivot-bolt, by Lloyd, Foster, and Co. Messrs. Thomas Dunn and Co., are the largest exhibitors of this particular class of machinery; the principal part of their collection is in a special shed in the Open Court, where the armour plates, conservatories, and other large articles are placed, in addition to which they exhibit a collection of models and drawings in the Western Annex.

LOCOMOTIVE ENGINES FOR ROADS

(TRACTION ENGINES).

Exhibitors.—**Bray's Traction Engine Co. (1805), A. Chaplin and Co. (1819), Ruston, Proctor and Co. (1977), B. D. Taplin and Co. (2003), J. Taylor and Co. (2004).**

These machines resemble, in general appearance, the ordinary transportable agricultural steam-engines, and are generally constructed with disconnecting gear; in order that the steam power may be used for driving thrashing machinery, &c., when necessary; as they are of great importance for agricultural purposes, especially for steam ploughing, many of them are exhibited in Class IX., among the other agricultural implements.

The original form of this engine, introduced by Mr. Boydell, where the driving-wheels run over a rail laid on hinged slippers carried on their circumference, is exhibited by Mr. C. Burrell in the Agricultural Gallery; the steering is effected by moving the front pair of wheels, which traverse about a universal joint, bearing in the middle of the axle.

Bray's engine is distinguished, by having a series of apertures in the driving-wheel tyres, through which, by means of an eccentric, a series of blades or teeth may be protruded, in order to gain additional hold or drag on steep inclines or soft ground; the power is transmitted by pinions on the crank-shaft, gearing into large toothed wheels in the driving-wheels. The engine exhibited is intended for service in Woolwich Dockyard, and is fitted with a windlass barrel and shears, to be used in lifting heavy weights, in loading or unloading waggons, &c. The steering is effected by a screw worm, and sector.

James Taylor and Sons' "Elephant" engine is one of the class, having broad smooth wheels; the driving power is transmitted as in Bray's engine, by toothed gearing; three separate sets of toothed wheels being provided, in order to vary the power, or speed, according to the nature of the ground, or the load to be drawn; the steering is effected by a pair of bevel wheels working on the front axle.

The traction engine exhibited by B. D. Taplin and Co., is distinguished by the peculiar construction of the smaller wheels which run on short independent axles, rendered capable of lateral motion, by means of jointed levers governed by the steering wheel; the frame carrying these can be elevated or depressed by a large vertical screw, in order that the inclination of the engine may be corrected, and the water in the boiler kept at its proper level, when travelling up or down steep slopes.

Messrs. Aveling and Porter's engine, in the agricultural department, is driven by means of an endless chain, which transmits the power from the engine to the driving wheels; the steering is effected by a single small wheel in front.

Two forms of steam coaches for roads are to be found in the Eastern Annex; they are principally distinguishable by their small size, and the direct communication of the power from the engine to the driving-wheels, without the intervention of toothed gearing.

A very special modification of the traction engine is that exhibited by Mr. Nathaniel Grew; this is a locomotive for running on ice; it was built for use on the River Neva, to convey goods and passengers between St. Petersburg and Cronstadt during the winter; in arrangement it resembles a tank engine with only one pair of wheels, 5 feet high, which are studded with steel spikes to obtain adhesion; the fore part of the boiler is supported on a frame with sledge runners, which is adjustable by means of a hand-steering wheel, placed on the driver's platform.

BOILERS,

INCLUDING TUBES, PRESSURE AND WATER GAUGES, COUNTERS AND INDICATORS, AND STEAM, GAS, AND WATER FITTINGS.

Exhibitors.—D. Adamson and Co. (1780), Allen, Harrison, and Co. (1782), R. Armstrong (1784), Baines and Drake (1788), F. W. Beaumont (1795), J. Beck (1796), R. and L. R. Bodmer (1801), Broughton Copper Co. (1808), P. Cameron (1811), H. Cater (1814), Chadburn Brothers (1815), J. Chandler (1817), D. K. Clark (1822), T. L. Clark (1823), F. J. Clowes (1825), Colquhoun and Thomson (1827), Eadie and Spencer (1843), H. Ferrabee (1851), Fricake and Gathercole (1857), W. and J. Galloway (1859), B. A. Grantoff and Co. (1865), F. Grimaldi and Co. (1869), R. Harlow (1876), J. Harrison (1877), Harris and Risse (1878), J. Hopkinson and Co. (1887), Horton, Son, and Kendrick (1888), Imperial Iron Tube Co. (1894), R. B. Lindsay (1911), Lloyd and Lloyd (1912), J. Louch and Co. (1914), McGlashan and Merryweather (1919), W. A. Martin (1925), E. H. C. Moncton (1933), E. Moore (1934), E. Murray and Co. (1937), Newton, Keates, and Co. (1944), J. Russell and Co. (1974), J. Russell and Sons (1975), G. Salter and Co. (1978), Smith Brothers, and Co. (1991), M. A. Soul (1992), Stephenson Tube Co. (1994), Stone, Settle, and Wilkinson

(1996), W. Stratford (1997), C. Topham (2010), Walker and Son (2014), F. Wise (2028), E. T. Wright (2032), York and Co. (2034).

Models and drawings of high-pressure steam boilers, designed by Messrs. Horton and Kendrick, are placed in the Eastern Annex. The principal novelties in these, consist in a combination of a number of cylindrical multitubular boilers into one, with the addition of a vertical series of tubes placed in the smoke box; another method of obtaining increased heating surfaces in locomotive boilers, is effected, by introducing a series of corrugations into the sides of the fire-box.

Another boiler, by W. and J. Galloway, is also illustrated by models placed near those last described; the heating surface is increased by a series of conical tubes, passing vertically through the body of the boiler; this plan has been successfully adopted in various factories in the United Kingdom.

A cast-iron boiler, designed by Mr. J. Harrison, presents several features of interest; it is made up of a series of hollow spheres united together, by internal wrought-iron tie rods. The joints are made steam tight, by the insertion of copper rings between the surfaces of contact of the balls: great portability, facility of repairs, and safety, are claimed for this system. A drawing is added to show the disposal of the furnace and setting. A drawing of a boiler, by P. Grimaldi and Co., furnished with trunnions for the purpose of rotation about its axis, is placed near the above. This arrangement is intended, to be productive of great economy in fuel, and to raise steam quickly. Mr. E. T. Wright's plan of constructing boilers with diagonal seams, is said to give an additional strength of 40 per cent., over the usual system of joining the plates in rings, having their edges at right angles to the longitudinal axis of the boiler.

A feed-water heating apparatus for locomotive boilers, by Mr. S. Bateson, deserves to be particularly noticed: it consists of a coil of tubes placed in the fire-box, through which the water passes before entering the boiler. The model exhibited represents the method as fitted to a locomotive on the London and North Western Railway. The saving of the fuel effected by its use amounted to 28 per cent., as deduced from an experimental trial of six months' duration.

Giffard's patent injector is a novel apparatus for supplying steam boilers with feed-water, by the direct impulse of a steam jet upon the water, without the intervention of any moving parts; it is exhibited in various sizes, adapted to every kind of stationary or locomotive boilers, by Messrs. Sharp, Stewart and Co.; it is applied to the majority of the locomotives exhibited, and is employed to feed the boilers which supply all the power used in the Building.

Mr. D. K. Clark's apparatus for smoke consuming is fitted to two of the boilers supplying the Western Annex with steam; an adjustable door is provided for the admission of air above the grate, and the air so admitted is equally distributed by three horizontal steam jets placed inside the furnace. Moveable fire bars for boiler furnaces are among the most important of recent improvements; several patterns are exhibited, varying from each other chiefly in the nature of the motion of the bars, some making the whole grate rock about one centre; others give a reciprocating motion to the alternate bars, the object in all cases being to prevent the adhesion of the ash and dirt left by the fuel, to the bars, by the rocking or sawing motion. As the whole of the bars are moved from one handle the work is more perfectly performed, with less labour than in the old process of clearing fires, where fixed bars are used.

A large assortment of copper tubes for steam boilers and other purposes, and copper and brass rollers for calico-printers, paper-makers, &c., is exhibited by the Stephenson Tube Company; all these articles are manufactured without seams or joints, having been drawn out from the solid by Parkes' patent process. The great ductility is obtained by the addition of a small quantity of phosphorus to the copper when melted.

Tubes made of wrought iron, and of the so-called homogeneous metal, are principally shown by Messrs. Russell and Co. of Wednesbury—several specimens which have been crushed under enormous pressure without breaking, while others have been tested to limits far beyond the ordinary working strains without yielding.

Mr. R. Bodmer's safety valve is intended to render the action of the valve more effectual, by providing a larger opening for the escape of steam, than can be obtained by the ordinary construction; this is effected, by the use of an independent lifting steam or water power, to support the valve as long as it may be necessary to keep it open.

A duplex safety-valve, invented by Mr. Ramsbottom, is exhibited by the London and North Western Railway Company; it consists of a combination of two valves, which are kept closed by a strong spiral spring placed between them, and acting equally on each by an equal armed lever. It will be seen on inspecting the model that no increase of weight can be thrown on to either valve without causing a corresponding relief to the other one.

Small accessory fittings for the use of steam-engines and boilers form an important group, which is largely illustrated, among which are, gauges for ascertaining steam and vacuum pressure; water level, and float gauges for boilers; salinometers, for ascertaining the amount of salt, in the water of marine boilers while under steam; indicators for ascertaining effective engine power, and counters for registering the number of revolutions made by engines. They are chiefly to be found in the Eastern Annex.

STATIONARY ENGINES.

Exhibitors.—Appleby Bros. (1783), J. P. Ashton (1786), E. T. Bellhouse and Co. (1797), Bellis and Seekings (1798), W. Benson (1799), Bunnett and Co. (1810), D. Chalmers (1816), Clayton, Shuttleworth and Co. (1824), J. W. Cowan (1830), C. S. Dawson (1836), Fawcett, Preston and Co. (1850), J. Ferrabee and Co. (1852), Gough and Nichols (1864), J. W. Gray and Sons (1866), Greening and Co (1867), J. W. Hackworth (1871), J. Hands (1873), E. Hayes (1881), J. Imray (1895), A. McOnie (1921), Manlove, Allcott and Co. (1924), W. May and Co.

(1927), J. Needham (1941), Peel, Williams and Peel (1954), Ransomes and Sims (1961), Routledge and Ommanney (1972), Sandys, Vivian and Co. (1981), G. Scott (1982), C. W. Siemens (1987), T. M. Tennant and Co. (2005), F. H. Wenham (2019), Whitmore and Sons (2028), W. P. Wilkins (2024), R. Wood and Sons (2029), W. L. Dorward (1841), F. Grimaldi and Co. (1869), J. Laird, Sons and Co. (1902), Earl of Orkney (1950), **Thornewill and Warham (2007), H. Tyler and Co. (2012), F. O. Ward (2015).**

In this department almost every variety of form of stationary engine is shown; the older form of beam engine is principally adopted by the constructors of heavy machinery, such as sugar mills and vacuum pan air-pumps.

In the engine by Wilkins, of Norwich, the beam has no fixed point, the end opposite to the piston being attached to an oscillating frame.

A pair of horizontal condensing engines, very compact and symmetrical in arrangement, by Barrett, Exall, and Andrewes, of Reading, are employed to drive the flax-spinning and weaving machines.

A horizontal double cylinder expansive engine, on Woolf's principle, with surface condenser, by W. May and Co., Birmingham, has the condenser formed of a long series of horizontal tubes, which are cooled by the action of cold water on their outer surfaces; the steam is condensed inside the tubes.

The advantage of surface condensers is most apparent in marine engines, as the cold salt water used for cooling the outer surfaces of the condenser-tubes does not come in contact with the fresh water produced from the steam; the boiler, after being once filled, can be continuously supplied with fresh water, and the waste of fuel consequent on the blowing of hot brine out of the boiler, at sea, which it is necessary to do, in order to prevent a deposit of salt, may thus be avoided.

The non-condensing horizontal cylinder pattern is largely illustrated in the various small engines, employed either singly or in pairs coupled together, to move the spinning, and other machines in motion.

The engine by Carrett, Marshall and Co., of Leeds, has two horizontal cylinders of unequal diameters, on Woolf's expansive principle; the cranks making an angle of nearly 180° with each other, simultaneous motion is produced on the pistons by means of one slide valve, the steam working expansively on the low pressure piston, on the same side as that on which it originally entered the high-pressure cylinder; the air-pump is worked by a continuation of either piston rod passing through the lower cylinder cover.

Messrs. Whitmore and Son, of Wickham Market, exhibit an engine arranged for a direct acting flour-mill; the crank shaft is vertical, the crank and fly-wheel being horizontal; the latter is placed within the bed plate.

Messrs. Bunnett and Co.'s engines, placed next to the large blowing engines in the Western Annex, are constructed on a very novel principle; the steam cylinders are replaced by curved chambers of a rectangular section, and the pistons by oscillating discs of a corresponding shape; the motion is communicated to the connecting rod by curved arms passing through stuffing boxes on either side of the curved steam piston cases; the distribution of the steam is effected by slide valves in a similar manner to that in use in the ordinary horizontal engine.

A pair of horizontal engines, arranged as a whim or winding-engine for a colliery, made by Messrs. Thornewill and Warham, is placed in the Eastern Annex.

MARINE ENGINES.

Exhibitors.—Humphreys and Tennant (1891), A. and J. Inglis (1896), T. Key (1897), T. Laird, Sons, and Co. (1902) Maudslay, Sons, and Field (1926), R. Morrison and Co. (1936), R. Napier and Sons (1939), J. Penn and Sons (1955), Randolph, Elder, and Co. (1960), Ravenhill, Salkeld, and Co. (1962), G. Rennie and Sons (1964), T. Richardson and Sons (1965), J. S. Russell (1976), Tod and M'Gregor (2009).

The collection of marine engines exhibited, includes full-sized examples of all the principal forms employed in screw propulsion. At the south end of the Annex, against the wall of the main building, is a pair of small engines of 60 H.P., by Tod and M'Gregor, having the steam cylinders placed in an inverted position, vertically above the crank shaft. The condensors are on the surface principle, that is, the steam is condensed by passing through a series of horizontal tubes, which are cooled by a current of sea water kept circulating around them; there are 750 of these tubes, each 6 feet long, and ¾ of an inch external diameter, giving a cooling surface of nearly 900 square feet.

The engines by J. Key, of Kirkcaldy, and those of 400 H.P. by Humphreys and Tennant, of Deptford, built for H.M.S. North Star, are somewhat similarly proportioned to the last, the cylinders being disposed horizontally.

The large engine of 800 H.P. by Messrs. Maudslay and Field, are constructed on a model which is extensively used in the Royal Navy; each piston is provided with two very long piston rods; the crank shaft is placed between the piston cross-head and the top of the steam cylinder; the position of the connecting rod being the reverse of that adopted in the previously-noticed forms; portions of an engine of 675 H.P. on the same system, are also shown.

An extremely beautiful set of models, five pairs of screw, and one of paddle-wheel engines, by the same firm, are exhibited in motion, and deserve to be particularly noticed.

Examples of the trunk or hollow piston rod, which allows the connecting rod to be attached to the centre of the steam piston, are supplied by Messrs. John Penn and Sons, who contribute a finished pair of engines of 600 H.P., intended for a Spanish frigate; and one cylinder, a connecting rod, and the crank shaft of the engines of 1250 H.P., constructing for H.M.S. Achilles; the diameter of the shaft is 18½ inches, and weighs between 18 and 19 tons; it was forged at the Mersey Steel and Iron Works.

A model by T. Richardson and Sons, illustrates an arrangement of the inverted cylinder form, similar to those of Tod and M'Gregor, but apparently intended, to be executed on a much larger scale; this model has the screw attached, and is exhibited at work.

Messrs. G. Rennie and Sons' engines of 200 H.P., for H.M.S. Reindeer, have both the steam and air pump piston rods, constructed on the trunk principle; the steam cylinders and air-pumps are disposed alternately on opposite sides of the screw shaft, instead of having both cylinders, or both condensers on the same side, as is usually the case.

Messrs. Ravenhill, Salkeld and Co. exhibit a small pair of oscillating engines for a paddle-wheel steamer; a model of screw engines of 500 H.P., for a war steamer, with surface condensors; a similar pair, with injection condensers, and a model of the oscillating engines of 720 H.P., built for the City of Dublin Steam Packet Company's mail boats. The Kingston and Holyhead mail service, for which the last-mentioned steamers have been built, is remarkable for the high speed and regularity with which the passages are performed; thus, between October, 1860, and October, 1861, the performance of the ships showed a total gain of 41 hours on the contract time, or about four minutes saving on each passage of 3¾ hours.

The engines by J. Laird and Co. resemble those by J. Key of Kirkcaldy, already noticed.

Messrs. Robert Morrison and Co.'s engines, placed in the right hand corner of the Eastern Annex, are distinguished by several notable peculiarities, such as the simplification of the arrangements for working the slide valves, and the use of surface condensers; the cylinders are vertical and inverted, the air and cold-water pumps are also vertical, and are worked directly from the steam pistons; the condensers are formed of a series of vertical tubes, contained in a rectangular chest attached to the framing, on the side nearest to the wall; the interior arrangements are shown in a series of sectional drawings, which merit a careful examination.

Woolf's principle of employing steam expansively in two cylinders, as adopted in several pairs of engines made for the Peninsular and Oriental Company, by Messrs. Humphreys and Tennant, is exhibited in a model. The same principle is extended by Randolph, Elder and Co., who construct each engine with one high pressure, and two expansion, cylinders.

DRIVING-BELTS AND GEARING.

Exhibitors—Cunliffe and Sons (1832), C. J. Edwards and Son (1845), Hepburn and Sons (1882), J. Holgate and Co. (1885), A. Mickelthwate (1929), Nobes and Hunter (1945), North British Rubber Co. (1947), Patent Frictional Gearing Co. (1953), C. A. Preller (1959), Webb and Son (2017).

Several novelties in driving belts, for the transmission of motive power, may be seen in both Annexes; new materials as wells as new methods of construction being exhibited.

Mr. C. A. Preller's belts are made of leather prepared without tanning; the leather is very dense and supple, and is shown by experiment to possess greater stability than that prepared in the ordinary way.

Messrs. Bryant and Cogan make their belts of narrow strips of leather placed side by side; the pulley is embraced by the cut edges, instead of the natural surface of the hide being used, as is the case in the ordinary belt.

It may be useful here to notice, that a further extension of the above principle is is to be seen among the French machinery in the shape of broad leather driving chains, made from the refuse of shoemakers' shops.

Mr. Mickelthwate's belting is made of a combination of tanned leather, wire, and hempen cord, and possesses great strength and flexibility.

Another compound material, made by the North British Rubber Company, a combination of cotton and india-rubber, is extensively employed in driving the machinery in motion; it is said to be much superior to leather, for use in damp places, and in mills where water is largely used.

The Frictional Gearing Company, of Glasgow, exhibit many small machines, in which their patent principle of transmission is applied. It consists, in gearing wheels together by frictional contact, instead of using teeth or cogs. This is effected, by furnishing the wheels with a series of annular V shaped grooves, so that the wedge-shaped ridges on one enter the corresponding furrows on the other. By the wedging contact so produced a powerful "bite" is established, causing one wheel to drag round the other.

MACHINE TOOLS.

Sub-Class B.

Exhibitors.—J. Alcock (1551), M. and H. Armitage and Co. (1553), C. de Bergue and Co. (1584), Beyer, Peacock, and Co. (1537), J. Buckton and Co. (1563), D. Cook and Co. (1575), S. Cooke and Sons (1576), Crawhall and Campbell (1581), Easterbrook and Allcard (1589), J. Evans and Son (1593), P. Fairbairn and Co. (1594), J. Ferrabee and Co. (1597), Fox Brothers (1599), W. Gadd and Son (1600), J. Glasgow (1607), Greenwood and Batley (1610), G. and A. Harvey (1616), Hetherington and Sons (1618), H. Holdsworth and Co. (1620), L. Holtzapffel and Co. (1621), J. S. Hulse (1625), J. Hunt and Co. (1626), Irwin and Sellers (1629), Kendall and Gent (1638), J. and J. Kershaw (1640), Maclea and March (1651), A. Mathieson and Son (1657), Muir and Co. (1668), R. Nash (1671), J. Nasmyth and Co. (1670), T. Naylor (1672), Patent File Machine Co. (1681), Peto, Brassey, and Betts (1684), J. Rhodes (1693), W. Ryder (1697), Shanks and Co. (1701), Sharp, Stewart, and Co. (1703), Shepherd, Hill, and Co. (1705), Smith, Beacock, and Tannett (1715), J. Smith (1719), Thwaites and Carbutt (1728), H. Whitfield (1740), J. Whitworth and Co. (1742).

The machines having for their object the manufacture of the detailed parts of machinery, are usually classed under the general head of Engine or Machine Tools. In some cases the motion imparted to the tool is continuous, as in the case of the screw-cutting lathe; in others, such as the slotting and planing machines, the cutting point works in a rectilinear direction, either horizontally or vertically, and the tool makes the waste return stroke, or a fresh surface is presented by the motion of the object, at a high speed, in order to prevent loss of time.

In the boring machine the cutters are arranged around the circumference of a horizontal or vertical rotating disc, which is continuously moved forward by a screw, placed parallel to the axis of rotation of the cutters.

The shaping machine is an engine combining the circular cutting motion of the lathe with the rectilinear action of the planing machine, thus allowing of the production of curves or spirals of the higher orders.

In the drilling machine, the tool has two cutting edges inclined to each other at an obtuse angle: in the vertical form of mounting it is fixed, and the work to be operated on is placed on travelling feed tables, in the radial machine the cutter is mounted on a projecting radial arm, and is thus capable of being put in action on any part of the surface of the object under operation, without altering the position of the latter.

The punching and shearing machines are usually combined into one instrument, as it is often necessary to perform both operations upon the same piece of iron, as in cutting the plates and piercing the rivet holes for wrought-iron girders, boilers, &c.

A very large assortment of each of the machines above described, will be found at the lower end of the Annex, between the marine engines and the spinning machinery; prominent among which, on account of size, are the planing machine of P. Fairbairn and Co., of Leeds, the radial drill, by Muir and Co., of Manchester, the punching and shearing machine, by J. Buckton, of Leeds, the large lathe for turning locomotive wheels, and the triple-headed slotting machine, shown by Beyer, Peacock and Co.

Most of the objects exhibited have their names attached, and some of them have unfinished pieces of work fixed on their tables, in order to illustrate their mode of action, among which are a locomotive wheel and tyre, on Messrs. Sharp, Stewart and Co.'s large double lathe, a crank axle on Messrs. Smith, Beacock and Tannett's slotting machine, a connecting rod on the slot drilling machine by Messrs. Sharp, Stewart and Co., and specimens of screw cutting by various exhibitors.

Wheel cutting engines are furnished by Messrs. J. Whitworth and Co., and Mr. J. Hunt; the former is intended for cutting the teeth of spur-wheels, by means of a rotatory disc of cutters, which cut out the spaces between the teeth. Mr. Hunt's machine is a large model of an engine, for cutting the teeth of bevel wheels, by means of a reciprocating tool resembling a graver.

Two file-making machines are exhibited in action by the

Birmingham File-Making Company; the steel-blank is fixed on a horizontal travelling table, and is subjected to the action of a chisel-shaped tool, which is driven against its surface by the combined actions of springs and a falling weight; the weight and tool are lifted by cams fixed on a rotating shaft.

Hall's multifarious punching and drilling machines are exhibited in small models by Messrs. Peto, Brassey and Betts; the first is capable of punching from 1 to 40 holes simultaneously; it has the punches arrayed in lines on the outer circumference of a horizontal cylinder; the dies are disposed in corresponding lines on a second cylinder; the drilling machine has 300 drills arranged in 15 parallel rows, a screw elevating motion lifts the table, and presses the work against the rotating drills, instead of the tool being moved downwards as the hole deepens, as is the case in the ordinary drill-hod.

Another multiple drilling machine by Messrs. Shanks and Co., is arranged to be driven without toothed or other gearing; each of the spindles is furnished with its own crank, the whole being driven by one connecting plate from the main shaft; the table with the work on it is mounted on the ram of an hydraulic press, instead of being lifted against the drill by screws, as in Hall's machine.

A form of steam rivetting machine, driven by a vertical trunk engine, is shown by Messrs. D. Cook and Co., of Glasgow. Near to it is a machine for making rivets, of a novel construction, by C. de Bergue and Co., of Manchester.

STEAM HAMMERS.

Exhibitors.—**De Bergue and Co. (1584), Eastwood and Sons (1591), J. Imray (1628), Kirkstall Forge Co. (1641), R. Morrison and Co. (1666), J. Nasmyth and Co. (1670), W. M. Neilson (1673), J. Rhodes (1693), Shanks and Co. (1701), Glen and Ross (1608), A. C. Wylie (1747).**

In the steam hammers constructed on Nasmyth's original plan, the weight is lifted by steam power, and allowed to fall on the anvil by its own gravitating action, consequently the maximum effect of the blow is measured by the impulse produced by the hammer block and piston falling with the velocity due to the length of stroke; by admitting the steam on the top of the piston, however, the only variable element, the velocity, may be increased, and the weight can thus be driven against the anvil at any speed obtainable from the steam pressure employed. By the adoption of this principle, small hammers of 2 cwt. can be rendered available for the heavier operations in general smiths' work. The small model of Naylor's patent double-acting hammer, shown by the Kirkstall Forge Company, has been driven at from 600 to 700 strokes per minute.

In Condie's patent modification, exhibited by Mr. A. C. Wylie, the steam piston is fixed, and the hammer block is attached to the moveable cylinder.

Mr. T. W. Cowan's hammer differs from the ordinary steam-hammers, in being lifted by a cam and lever motion, driven from a rotating shaft; a cylinder in the place occupied by the steam cylinder, in the direct acting hammer, serves as an air vessel for the purpose of regulating the blow, diminishing it, when a cushion of compressed air is allowed to remain under the piston, and increasing it, when the compressed air is allowed to act on the upper piston surface.

Messrs. Robert Morrison and Co.'s hammer is distinguished by having the hammer block, piston, and piston rod forged in one solid piece; a continuation of the piston rod passes through the top cylinder cover, and has one side planed flat, in order to serve as a guide, an arm is attached to the top of the rod bearing a roller which moves in a curved slotted link, for the purpose of working the steam valve.

The hydraulic steam-hammer of Imray and Copeland derives its name from the fact of its having an intervening liquid cushion placed between the hammer block and the piston rod. The anvil is mounted on the ram of an hydraulic cylinder; the object of these modifications is to get rid of the destructive effect of the shocks, by diffusing it equally over the foundations by means of the interposed liquid.

WOOD-WORKING MACHINES.

Exhibitors.—C. Board (1559), Cox and Son (1579), W. Eassie and Sons (1588), Forrest and Barr (1598), W. Geeves (1603), Greenwood and Batley (1610), J. Jones (1633), J. Lewis (1648), J. MacDowall and Sons (1652), Powis, James, and Co. (1688), T. Robinson and Sons (1695), E. Smith (1717), R. H. Thompson (1727), Weston and Horner (1738), Worssam and Co. (1745).

The principal articles comprised under this head are sawing, planing, moulding, mortising, and tenoning machines, and machines for reproducing carved forms.

Vertical saw frames for cutting deals, with from ten to twelve parallel saws in each, are exhibited in various modifications by Messrs. Powis, James, & Co., S. Worssam & Co., Forrest & Barr, T. Robinson & Son, and J. & T. Young; most of the above firms also exhibit circular saw benches.

Mr. William Geeves' saw frame has the saws placed horizontally instead of vertically; the framing and arrangements resemble those of a horizontal steam-engine: this pattern has been adopted to frames carrying sixteen saws.

A particular modification of the circular saw is applied in a machine for bevelling the edges of barrel staves, one of a large number employed in the manufacture of ammunition barrels at the Royal Arsenal, Woolwich: it has two small circular saws mounted on jointed frames so that the angle between their cutting planes may be varied according to the amount of bevel required. The band-saw, which is an endless ribbon-saw working over two large rollers, is shown by Messrs. Powis, James, & Co.; this instrument has the advantage over the vertical-frame saw of being continuous in its action, and, the blade being thin and narrow, it can be used for cutting along curved surfaces; in Messrs. Greenwood & Batley's modification the frame carrying the upper roller is made adjustable by a toothed sector and pinion, in order that the inclination of the cutting plane, to the surface of the table, may be varied at pleasure.

Large planing machines are exhibited by most of the firms mentioned above. The arrangement used is generally a combination of fixed and rotating cutters with a roller feeding motion, the fixed plane irons being employed for smoothing the upper face of a flooring plank, while the other face is planed by the horizontal, and the sides are tongued and grooved by the vertical cutters, the whole of these operations being performed simultaneously; the same machine can be used for making mouldings, by removing the straight-edged fixed planes, and replacing them by a tool of the appropriate pattern.

The mortising machines have either long slender chisels working through the wood from above, or a combination of two tools is used, working from above and below simultaneously, so that a cutter of half the length is sufficient. Worssam and Co.'s mortising machine has the chisel made hollow to allow the augur to work inside it.

The cutter frames of the tenoning machine rotate vertically in a similar manner to those which are used for tonguing and grooving on the planing machine. For making double tenons, a horizontal circular saw is added, with a blade equal in thickness to the space to be removed between the two tenons.

Messrs. Cox and Son exhibit wood-carving machinery, which operates in the following manner: the object to be copied, and the block or blocks to be operated on, are placed side by side on a horizontal bed; by means of two motions at right angles to each other, the table can be moved by hand, so as to cause a fixed vertical rotating drill to act on the surface of the block, at the same time that the workman causes the model to pass under a fixed copying point; the cutting power of the tool in depth can be varied by the use of a treadle, increasing or diminishing the downward pressure. Mr. T. B. Jordan is the inventor of this machine.

Among Messrs. Greenwood and Batley's collection will be found a machine for cutting out the lock seat in gun stocks, being one of a large series used in the manufacture of military rifles: it resembles Mr. Jordan's machine in so far that the cutter works parallel to a tracing point moved over the finished pattern; but a series of drills, each having its power of action limited to a particular depth, is employed, instead of providing for a varying cutting power by a motion governed by the foot; these cutters are arranged on a cylindrical frame, and each one has its own tracing point; the motion is communicated by frictional bevel wheels, and two small fan-blowers are added, in order to keep the work and pattern free from chips and cuttings.

SPINNING MACHINERY.

Exhibitors.—**J. Apperly and Co. (1487), J. P. Clarke (1489), J. Combe and Co. (1491), Cotton Supply Association (1493), T. Crabtree (1494), E. and J. Davis (1495), J. Dixon and Sons (1498), Dobson and Barlow (1499), P. Fairbairn and Sons (1501), J. Ferrabee and Co. (1502), J. Gordon (1504), J. Haley and Sons (1505), T. R. Harding (1506), Hetherington and Sons (1511), W. Higgins and Son (1513), R. E. Hine and Co. (1514), S. Lawson and Sons (1520), Maclea and March (1521), J. Mason (1522), T. and G. Morrison (1523), C. Parker and Son (1526), J. Perry (1527), Platt Bros. and Co. (1528), Reynolds Brothers (1529), J. Rowan and Sons (1531), Sharp, Stewart and Co. (1532), James Thompson and Co. (1536), Walker and Hacking (1538), L. Wilson and Sons (1541), Wren and Hopkinson (1543).**

The machines used in spinning cotton into yarn are variously graduated systems of arrangements, having for their object the cleansing, sorting, and twisting of the fibres of the raw cotton. The cotton when gathered is subjected by the grower to the action of a machine called the gin, for the purpose of cleansing it from the seed; it is then press-packed for exportation. On arrival at the place of manufacture, the first operation in spinning is performed by the opening or scutching machine, which cleans the raw cotton from dirt and short fibre by the joint action of a rapidly revolving system of beater-arms and an exhausting fan-blower, which draws out all the dust and fine particles; the cleaned cotton is delivered between a pair of rollers in the form of a broad thin sheet or lap, which is coiled on to wooden rollers ready for delivery to the carding engine.

In the carding engine the fibres of the lap are sorted into parallelism by means of oblique wire teeth, variously arranged on the surfaces of revolving rollers; the carded cotton is removed from the teeth of the delivery or doffer cylinder by a reciprocating knife or comb, and is passed through a conical or funnel-shaped opening, which contracts it to a ribbon or sliver, which is delivered through a pair of drawing rollers into a tin can. It is usual to repeat the operation of carding in engines having teeth of varying degrees of fineness; the coarser ones are known as breaker cards, the finer ones are called finisher cards.

A more elaborate engine is used for the purpose of carding in the manufacture of fine yarns; it is called the combing machine, and in addition to combing, it separates the longer from the shorter fibres. One is exhibited by Messrs. Hetherington and Co.

In the next engine, the drawing frame, the slivers or card ends are drawn out between sets of horizontal rollers, each advancing pair revolving at a higher velocity than the pair immediately preceding it; the drawn slivers so produced are repeatedly doubled and redrawn, in order to obtain a high degree of uniformity and tenuity.

In the next operation the twist is communicated to the drawn slivers by means of forked spindles revolving vertically, which deliver the cotton on to reels or bobbins in the form of a loosely twisted cord or roving: this process is performed by several steps in machines known as "slubbing, intermediate, and roving frames."

The rovings are next delivered to the spinning machine or mule, where they are drawn, twisted, and stretched into finished yarn by the combined agency of drawing rollers and rapidly rotating spindles, arranged on a travelling frame. The yarn from the mule is delivered in the form of cops or spindle-shaped bundles ready for the shuttle, to be used as weft thread; warp yarns are spun on the throstle frame, a fine variety of the roving and fly frame, and are delivered reeled out to bobbins.

In preparing and spinning flax, the general outline of processes is as follows. The ripened flax stems are subjected, according to different plans, either to the action of cold or hot water or high-pressure steam, in order to decompose the gum and extractive matter combined with the fibre; the stems after being so decomposed or retted are treated in the scutching mill, where the adherent woody fibre is removed by bruising between toothed rollers; a portion of the shorter fibre is also removed by this operation, and forms an inferior product under the name of scutching tow.

The long fibres from the scutching mill are sometimes cut into lengths by the cutting machine, a coarse circular-saw arrangement, in order to equalize their quality; the top and root ends being much inferior to the middle portion, are separated and spun with the tow produced in scutching and hackling.

The long line from the scutching and the cut line from the cutting machine are next combed or hackled in the hackling machine, by metal points projecting from the surfaces of cylinders or endless belts; the shorter fibre or tow is treated in carding engines of a particular construction.

The subsequent processes of drawing, roving, and spinning, are performed by machines analogous to, but differing in construction from, those used in cotton manufacture.

In the manufacture of woollen yarns the products are possessed of different qualities, according to the nature of the raw material, which is classified into long wool or combing wool, used in the manufacture of worsted, and short wool or clothing wool, which, from its property of felting, is eminently adapted for making cloth.

The long wool after being washed and dried is transferred to a machine called the plucker, where it is straightened and cleaned by fluted rollers and a fanning apparatus. After the cleaned wool has been oiled, the next operation is that of combing, which is either performed by hand or machinery, the teeth being arranged in a somewhat similar manner to those of the flax hackling machine; the operation of combing has to be performed with heated combs, in order to render the fibres soft, flexible, and elastic; this is accomplished in machine-combing by means of high-pressure steam; in hand-combing the combs are heated by a stove.

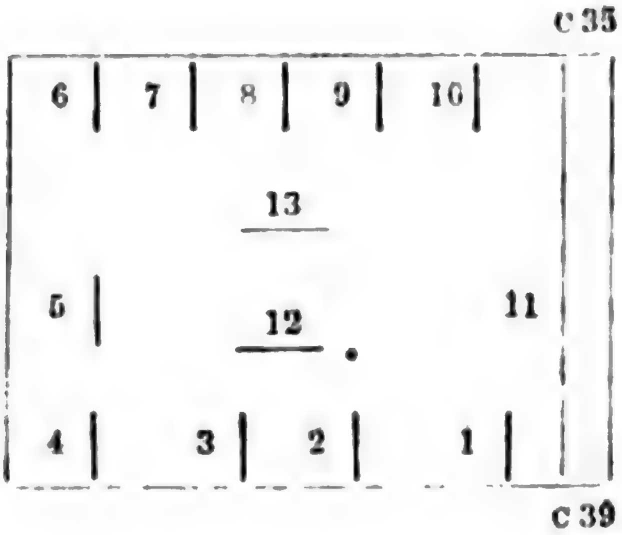
The processes of drawing, roving, and spinning, are performed on similar machines to those used in making cotton yarn, the difference being chiefly in the distance between the rollers, and the draught of the roving, which is much greater for wool than for cotton.

Short wool for cloth is somewhat like cotton in the structure of its fibre, and is subjected to similar preliminary cleaning processes; after being oiled it is subjected to a first carding or scribbling operation, which converts it into a lap for the carding proper, where it is formed into a narrow band or sliver. The card ends are converted into a continuous loose cord, or roving, in the slubbing machine, or billy, by means of vertical spindles mounted on a travelling frame: these rovings are afterwards spun in the mule frame in the usual way.

The processes of silk spinning commence with winding the skeins of imported raw silk on to bobbins, which is effected in an engine called the throwing frame; the next operation consists in doubling or winding the threads of two or three of the bobbins from the throwing mill on to one reel; in the spinning mill the doubled thread is subjected to a twisting operation, by means of spindles and fliers, analogous to those of the throstle frame used in cotton spinning.

It will be easily understood, that the greater simplification of the process of spinning the silk of the ordinary silkworm is due to the fact of the great length and regularity of the fibre, rendering the use of carding engines and drawing rollers unnecessary; the silk obtained from some insects, however, is carded and spun like cotton.

There are probably no classes of machines more fully illustrated than those which have been briefly noticed in the above paragraphs: a plan is added, to give some idea of the general arrangements of a train of cotton-spinning machines; it represents the collection exhibited by Messrs. Dobson and Barlow:—



1. Opener.
2. Scutcher.
3. Breaker card.
4. Lap machine.
5. Finisher card.
6. Drawing frame.
7. Slubbing frame.
8. Intermediate frame.
9. Roving frame.
10. Jack frame.
11. Mule.
12. Grinding machine for flats, rollers, and clearers of carding engines.

Messrs. Platt Brothers' collection comprises a complete and varied series of cotton and wool spinning machines, all of which have their names marked on them, and a plan of their arrangement is also exhibited.

Messrs. J. Hetherington and Co.'s machinery is arranged for working with East Indian cotton.

WEAVING MACHINERY.

Exhibitors.—**Booth and Chambers (1488), T. Whitesmith (1542), Tuer and Hall (1537), J. and W. Stuart (1535), W. Smith and Brothers (1533), J. and R. Robinson and Co. (1530), J. Perry (1527), C. Parker and Sons (1526), J. C. Oldham (1525), Jackson and Graham (1517), G. Hodgson (1515), Henderson and Co. (1510), G. Hattersley and Son (1509), J. Dugdale and Sons (1500), W. Dickinson and Sons (1497), S. De Bergue (1496), Anderston Foundry Co. (1486), Gatenby and Pass (1503), T. and G. Morrison (1523), T. Harrison and Sons (1508).**

A large collection of power-looms, for the manufacture of every kind of textile fabric, from the plainest to the most complicated, is placed in the Western Annex. As they are all exhibited in action, it will scarcely be necessary to do more than give a few general notions as to their construction.

The principal invariable parts of every loom are—1. The warp beam, a horizontal roller on to which the parallel horizontal threads to form the warp are wound. 2. The reed, a narrow grating of fine steel bars, mounted on a vibrating frame for the purpose of driving up the weft; each warp thread passes through one of the fine apertures between the dents. 3. The shuttle, a small boat-shaped instrument carrying the weft thread, which is propelled backwards and forwards across the warp by a pair of wooden arms called picking-sticks. 4. The healds or heddles, a series of cords, provided for the purpose of lifting or dividing the warp threads. 5. The taking-up roller placed in front of the loom, on to which the finished cloth is wound.

There are three motions attending every throw of the weft—the shedding or dividing of the warp, the shoot or passage of the shuttle across the divided warp, and the driving-up of the weft by means of the reed; in the plainest variety of fabrics the heddles are arranged into lifts or leaves, so that alternate threads of the warp are raised or depressed for each throw of the shuttle.

In weaving patterns, the process of combining the heddles into lifts is adopted for the production of simple geometrical figures; various methods are adopted for working the lift, among which will be seen a plan in which the device is marked by lines of pins or studs on a rotating barrel, like the barrel of a musical box.

In the production of transversely striped or checked articles, differently coloured weft threads are employed; for this purpose the shuttles are carried in sliding or rotating boxes.

In more complex weaving, each heddle is worked by an independent lifter; the proper division of the warp is effected by the well-known jacquard arrangement, which consists of a series of pasteboard cards, pierced with holes, one being provided for each shoot of the weft, required to form the pattern. These cards are linked together into an endless chain, which is passed over a hollow box at the top of the loom; the blank portion of the card acts on the levers working the particular warp threads required to be raised, while the levers opposed to the perforation pass into the holes without being affected.

The jacquard arrangement is superseded, in the loom invented by Mr. Bonelli, by the use of a series of electro-magnets for working the lifters: this beautiful contrivance is exhibited in the Italian machinery department.

Velvet and carpet looms differ from the plain loom, by having two sets of warp thread, one serving as the foundation, and the other for the pile or raised loop; the loops are formed upon wires inserted at each throw of the weft, which are withdrawn when the weft has been beaten up: for forming the pile in velvet the loops are cut through. A silk velvet loom worked by hand is to be seen in the Process Court.

Messrs. J. Harrison and Son exhibit a complete set of machinery required in the various processes of plain weaving, according to the following arrangement. The first process is performed by the winding machine, which winds the yarn from the caps received from the spinner, on to spools or bobbins called warpers' bobbins, for the purpose of warping or beaming; it has also an arrangement for winding from throstle-bobbins.

The warping machine winds the yarn from the bobbins filled in the former process on to beams ready for the sizing or dressing machine: the drum or cylinder on which the beam revolves is made in such a manner that it may be expanded or contracted according to the width of the beam required to be used; a self-acting measuring and stopping motion stops the machine as soon as the required quantity of yarn is wound on the beam. In the sizing machine the yarn is brought from the warpers' beams through boiling size, and passed over drying cylinders, after which it is wound on to the weavers' beam ready for the loom; arrangements are added for working the machine by friction, and for preventing any tension being put upon the yarn while in a wet state: in order to economize fuel, the exhaust steam from the drying cylinders is intended to be used for the purpose of boiling the size.

One machine is capable of preparing 100,000 yards of warp weekly, a supply sufficient for 300 looms.

The series is completed by three looms intended for weaving light and heavy cotton cloths and linen; they are distinguished by improved taking-up rollers made of iron, instead of the ordinary wooden roller covered with emery, the disadvantage of which is, that it becomes swollen or warped according as the weather is damp or dry, causing great irregularity in the cloth; weft-stopping motions, for stopping the loom when the weft is broken or absent, and metallic picking motions, for propelling the shuttle, are also provided.

Messrs. Booth and Chambers' loom is distinguished by various novel peculiarities—among others, the warp beam is mounted so as to cause the warp threads to be equally strained, whether the roller be full or empty, without varying the balance weights; the taking up of the cloth is accomplished by eccentric wedges on a plain beam, thus dispensing with the use of the emery covered roller, which is objectionable on account of its preventing the use of wetted weft. The makers of the above, Messrs. Tuer and Hall, are also exhibitors of looms, among which is an improved carpet loom, capable of producing pile velvet, patent tapestry, or ordinary Brussels carpet of any width required, with or without jacquard. All the working motions, except the crank, are placed outside the loom, in order to render them easily accessible; the motion for inserting and withdrawing the wires, on which the pile or loops are raised, is governed by one cam. Six of these looms, each capable of producing five yards per hour, or two yards more than the ordinary loom, may be driven by one horse-power. The loom is exhibited, making patent tapestry carpet, in which the pattern is produced by plain weaving, each thread of the pile warp being dyed in various colours, the whole working up into a flowered pattern when woven.

SEWING MACHINES.

Exhibitors.—**Bradbury and Co. (1560), W. Carver (1566), Deane and Davies (1583), Guinness and Co. (1612), W. Keith (1637), McKenzie and Co. (1653), L. McKernan (1654), Newton Wilson, and Co. (1675), W. Pearson and Co. (1682), S. C. Salisbury (1698), W. Service (1700), R. E. Simpson and Co. (1708), J. Smith and Co. (1718), W. F. Thomas and Co. (1726), Victoria Sewing Machine Company (1733), Whight and Mann (1739).**

These instruments are exhibited in considerable numbers, both for manufacturing and domestic purposes, in the Process Court. They are divisible, according to the nature of the stitch, into chain, lock, and knotted stitch machines; the two latter classes being worked with two threads, and the first with a single one. The chain-stitch is formed by a hooked instrument under the cloth, keeping open the loop of the thread brought down by the needle until it is secured by the next loop formed in the succeeding stroke. The appearance of the finished work differs on the upper and lower surfaces, showing a single line of thread on the former, and a chain of loops on the latter side. In the lock-stitch machine the upper loop is secured by a second thread passed through by means of a fixed or moveable shuttle; the finished work on hard cloth shows an intermittent single line of thread on its upper, and a continuous line on its lower surface; but when the fabric is thick or soft the stitch appears to be intermittent on both sides.

In the third class, or knotted-stitch machines, the loop brought down by the needle is secured by an instrument bringing a loop of the lower thread into it. This second loop is kept open until the next descent of the needle, when both threads are drawn tight together. This form of stitch is more secure than either of the foregoing ones.

Note—**A brief history of the sewing machine, abstracted from Professor Willis's report, will be found at page 286.**

BLOCKS FOR SHAWL-PRINTING.—ENGRAVING FOR CALICO-PRINTING.

Exhibitors.—John Wright (1746), J. Lockett, Sons, and Leake (1649), Henry Garside (1602), Morgan and Co. (1663).

A small number of very interesting and beautiful machines are included under this head: those for producing block patterns are in the Process Court; the engraving machines are in the lower part of the western avenue of the Western Annex.

Morgan's patent machine for making shawl-printing blocks produces a hard printing surface by the insertion of brass wire pins into a prepared block of wood. The effect of flowing lines is more or less perfectly produced according to the fineness of the wire employed. The finest patterns yet produced have been obtained by using wires 1-64th of an inch in diameter.

The process patented by Mr. John Wright produces moulds by the action of finely-pointed tools heated by a gas flame upon wooden blocks; type-metal casts of the burnt-in pattern so obtained form the printing blocks. Two varieties of the machine are exhibited, one producing a single impression, and the other capable of forming patterns on the upper and under surfaces of the wood blocks by the simultaneous action of two heated points worked by one heddle.

Pentagraphic machines, for engraving rollers for printing calico or paper-hangings, are exhibited by Messrs. Lockett and Co. The most improved variety, constructed on Shields' patent, is capable of producing twenty-four reduced copies of a design at one time from a single pattern. The sketch is drawn, on a large scale, on a flat piece of zinc, and by going over it with a tracing point, a number of reduced copies corresponding to the number of diamond points employed, are produced on the roller. The pentagraph is capable of effecting any reduction of a pattern included between the limits of one-half and one-twelfth of the original size.

Mr. Henry Garside's electrographic engraving-machine is intended for engraving the designs on brass or copper rollers for calico printing in the following manner. The cylinder is coated with a resisting varnish, through which the design is scratched by a series of diamond points, arranged so as to be worked, each by a separate electro-magnet; the action of the magnets is determined by their being put in or out of circuit, according to the requirements of the pattern. The pattern is drawn in a non-conducting varnish on a small, bright, metal cylinder, revolving horizontally; a tracing point pressed against the pattern, and moved by a self-acting slide motion, puts the magnets in or out of circuit, according as it is in contact with the bright metal or the varnish-covered surface. The requisite reduction of the pattern is effected by means of a train of spur wheels, by which several revolutions of the pattern cylinder are made for each revolution of the roller to be engraved. The traced outlines on the cylinder are subsequently etched in by nitric acid or some other biting liquor.

PAPER MACHINES.

Exhibitors.—**G. Bertram (1555), B. Donkin and Co. (1585), D. and J. Greig (1611), T. F. Marshall (1656), A. Siebe (1706), J. Smith and Son (1720), G. Tidcombe and Son (1729).**

Two examples of this kind of machinery are shown among the English machinery, near the middle of the Central Avenue, between the large machine tools and the spinning machines; they are contributed by Messrs. Bryan Donkin and Co., and Mr. C. Bertram, of Edinburgh.

The operation of the paper machine is as follows:—The pulp of cotton, or other vegetable fibre, is evenly distributed in a continuous stream over the surface of an endless wire cloth, where it is partially compacted by a vibratory motion of the travelling wire gauze; a further portion of the moisture is removed by passing the thin sheet of pulpy matter through partially exhausted air boxes; the wire delivers the moulded paper to a continuous band of felt, after which it receives the water-mark by being passed under the surface of a wire roller, having the necessary figure woven into it, called a "dandy roller;" the water-marked paper, still supported by the felt, is then finished and dried, by being passed between pairs of pressing rollers, and finally through a series of large rollers heated by high-pressure steam. The process of rolling is repeated in order to equalize the paper by subjecting both surfaces to its action.

Various parts and materials of paper-machines are furnished by other exhibitors; specimens of the continuous wire-gauze moulds may be seen among the articles belonging to Messrs. Bryan, Corcoran and Co., in the Eastern Annex.

Bank-note moulds and figured rollers, or dandy rollers, and a knotter-plate or pulp strainer, are to be found in the immediate vicinity of the large machines.

Mr. C. T. Youngman's machines for making paper bags are exhibited in action. For making rectangular bags two lengths of paper are used, one of which is smeared with paste along two parallel folded edges; to form the sides the other one, supplied from a web of paper placed at right angles to the first, is only pasted on one edge, in order to form the lower seam; the proper lengths are cut off by two falling knife blades; the pasted sides are pressed together by passing through a pair of rollers. A simpler form of machine for making triangular bags is at work in the Process Court.

TYPE-FOUNDING MACHINERY.

Exhibitors.—R. Besley and Co. (1556), Johnson and Atkinson (1632), Miller and Richard (1659), J. and R. M. Wood (1744).

These machines are among the most popular objects in the Western Annex; that by R. Besley and Co. somewhat resembles the old hand-mould mounted on a vibratory frame. The alloy for forming the type is kept melted in a cistern placed over a gas-burner; a small force-pump forces a jet of the melted metal into the mould at the moment that the frame is in contact with the side of the cistern. The mould is formed of two pieces hinged together, which are opened on the return stroke of the frame, and a jerking motion causes the finished type to fall clear of the machine into a box placed for its reception. The type, when removed from the mould, has a runner or projecting piece attached to its lower end, which has to be removed by hand, and the sides require to be smoothed before it is ready for use.

Messrs. Johnson's and Atkinson's type-founding machine, placed in the same enclosure with Mitchel's composing and distributing machines, differs considerably from the one last described. The mould is placed horizontally, and is formed of three pieces, which are separated after each casting. The type cast at each stroke is pushed out of the mould on to a travelling apparatus, which carries it forward to a cutter, where the runner or projecting piece of metal is removed; it is afterwards passed on to a series of saw-like cutters, which plane the sides smooth, and is delivered in a finished state.

Messrs. J. and R. Wood exhibit a series of machines for making stereotype moulds in papier-maché, and specimens of the moulds and stereotype plates obtained from them.

TYPE-CASTING AND COMPOSING MACHINES.

Exhibitors.—**R. Besley and Co. (1556), J. Coryton (1577), Johnson and Atkinson (1632), W. H. Mitchel (1662), Young's Print Type Co. (1750).**

Mr. Young's patent type-composing and distributing machines are intended to facilitate the process of setting up type for letterpress printing. The composing machine is provided with a series of keys like those of a piano, one for each letter of the fount or set of type. By striking the keys the letters are allowed to fall out of the holders above the frame into a series of curved gutters cut into the face of an inclined plane, down which they travel into a horizontal receiving apparatus. The set-up type is delivered by the machine in long lines at the rate of 12,000 to 15,000 letters per hour, according to the skill of the compositor. The justifying apparatus receives the lines of set-up type, and the compositor divides up the matter line by line into the proper length. The completed portions are successively depressed in the frame by moving a handle in order to make room for the next line: about 4,000 types can be justified, in this manner, per hand per hour, so that it will require three justifiers to work up the material supplied by one composing machine.

The type-distributing machine is complementary in its action to the above; that is, it effects the dispersal and return of the set-up types to their appropriate places, ready for further use. This is effected by means of distinctive notches in the type, which vary in number and position for different characters: about 18,000 single types can be distributed per hour by its use.

Mitchel's type-composing machine is worked by keys in a similar manner to Young's; the types are held in shallow brass troughs, inclined at a high angle; a series of horizontal tape bands are kept constantly travelling under them; when a key is depressed a catch at the bottom of the corresponding type-holder is released, a type falls on to the tape passing under it, and is carried off and dropped over a brass shoot on to another endless band running along the back of the machine: this second band in its turn delivers the letters, arranged in order, to a vertical wheel having a series of steps on its circumference which carry them down to the point of final delivery, for as each step passes below the horizontal line the type standing on it falls forward into a narrow brass frame placed for its reception.

Mitchel's distributing machine receives the lines of composed type to be broken up from a narrow brass trough, on to the circumference of a conical rotating drum, having a series of depressions, each capable of holding a single type; the characters so received remain on the drum till they arrive in front of the channel placed for their reception, when they are pushed off by a series of eccentrics which are hidden in the interior of the machine.

PRINTING MACHINES.

Exhibitors.—Annable and Blench (1552), C. Board (1559), E. E. Colley (1572), W. Conisbee (1574), Day and Son (1582), B. Garratt (1601), D. and J. Greig (1611), Harrild and Sons (1613), C. M. Harrison (1615), Hughes and Kimber (1624),

Holtzapffel and Co. (1621), Lavinia Jones (1634), McQueen Bros. (1655), M'Queen Bros. (1667), D. Napier and Sons (1669), H. R. Palmer (1679), Petter and Galpin (1685), J. Ross (1696), Madame C. Sinibaldi (1710), E. and W. Ullmer (1730), Waterlow and Sons (1734), J. and R. M. Wood (1744).

The largest example in this branch of machinery is furnished by Mr. John Ross, of Leith, who exhibits a double-cylinder steam press, with a self-acting feeding apparatus, suitable for illustrated and other fine work; it is placed next to the paper machines in the Central Avenue, Western Annex.

A model of the machine used in printing the Daily Telegraph, capable of producing 25,000 impressions per hour, by E. Colley, illustrates the latest improvements made in newspaper printing; it has ten small pressure cylinders arranged around the circumference of one large central horizontal cylinder, which carries the type and the inking-table on its circumference; ten rollers for inking the type alternate with the smaller cylinders. The action is as follows:—the inking-table supplies the ten rollers once in each revolution with ink, which is transferred to the type in its passage; the impression is produced along the line of contact of the central drum with the smaller cylinder, upon a sheet of paper held between them.

Various hand presses for letter-press, lithographic, and copper-plate printing, are grouped, with paper-cutting machines, in the Western Avenue, between the smaller machine tools and the power looms.

The method of printing in tinted lithography is exhibited in action by Messrs. Day and Co., in the Process Court.

Small single cylinder presses are shown by Mr. W. Conisbee, and Messrs. Petter and Galpin; the latter firm have given their press the name of "The Belle Sauvage Machine." A large machine by Messrs. D. Napier and Co. illustrates one of the newer modifications, namely, the substitution of the old form of "platten," or plane surface pressure, for that produced by rotating cylinders.

Messrs. Waterlow and Sons' railway-ticket printing machine is employed in numbering, perforating (for return tickets), and printing, by one operation: the plain tickets are inserted in a tube on the right-hand side and are passed out on to a plate, where they receive the impression from the numbering and type forms which are lifted against them from below, at the same time a perforating knife pierces them in the middle. The type form, and lettering discs, are inked by separate rollers, which receive their supply from a large feeding roller, capable of being moved forward and backward by a screw combined of a right and left handed thread on the same barrel; the finished tickets are discharged through a passage similar to the feeding tube placed on the left-hand side of the machine.

Messrs. Harrild and Son's newspaper addressing machine is intended for the purpose of rapidly printing the address covers for newspapers and other serial publications; the addresses are set up in a galley or frame, and placed in the bed of the machine, which is arranged so that it may be moved by the foot: a different address is produced at each impression.

BRICK-MAKING MACHINES.

Exhibitors.—**Bradley and Craven (1561), Bunnett and Co. (1564), H. Clayton and Co. (1570), P. Effertz (1592), J. P. Oates (1677), E. Page and Co. (1678), Sharp and Bulmer (1702), W. Wilson (1743).**

The machines for making bricks, pipes, and tiles are scattered over both the Annexes. On the western side those exhibited by Henry Clayton and Co. will be seen, in the position indicated on the plan, in motion, but not at work: the large machine is compounded of a pair of rollers for crushing down hard masses in the brick earth, a horizontal pug mill, where the crushed earth is tempered by a series of screw blades, and a rectangular moulding chamber, out of which the tempered clay is expelled through die-plates, placed on two opposite sides by the reciprocating action of a piston. The two shorter sides of the die-plates are bounded by vertical rollers, covered with an elastic material, which serve to smooth the sides of the stream of clay as it issues from the moulding-box; the continuous prism formed at each stroke of the piston is divided into bricks by a number of cutting wires mounted on a vibrating frame.

Messrs. Bradley and Craven's machine for making pressed bricks is placed in the Eastern Annex: it consists of a revolving horizontal plate, containing a series of moulds, arranged in pairs, each of which is filled as it passes under the pug mill containing the tempered clay; while the moulds are filling the table is stationary, and the two filled moulds on the opposite side are at the same time subjected to a considerable pressure by special pistons; two finished bricks are removed from the table during the same interval; the bottom of the mould is moveable and attached to a piston, which is lifted by passing over an enclosed plane or vertical cam, in order to remove the finished brick from the mould, an operation which is performed while the table is in motion.

Bunnett and Co.'s brick machine is continuous in action: the clay is received on a broad flat rimmed wheel, and is sent forward through the mould by a series of rotating cams, which force it out in a continuous stream through the die-plate.

PEAT FUEL MACHINE (1562).

A machine exhibited by Mr. Brunton is intended for the purification of peat by the removal of roots and coarse fibres; this operation is performed by subjecting the freshly dug peat to the action of a pugging screw, working in a conical case filled with small holes: the valuable burning matter is forced through these holes, and drops on to an endless travelling band, which delivers it to a brick machine, where it is moulded into blocks for drying; the coarse fibres that will not pass through the holes of the strainer, fall into a waste pipe and are rejected. The prepared peat is exhibited in Class I.

HYDRAULIC MOTORS (TURBINES, &c.)

Exhibitors.—B. Donkin and Co. (1840), North Moor Foundry Co. (1948), Messrs. R. Roberts and Co. (1968), Warner and Son (2016), Williamson Bros. (2026), Whitmore and Son (2023).

The greater number of examples of this class of machinery, including some of the largest and heaviest of those in motion, are placed at the northern end of the English department of the Western Annex; the fire-engines are among the carriages in the gallery on the south-eastern side of the main building.

There are various methods employed to obtain motive power from a natural fall of water, the principal ones being, the vertical wheel, the horizontal wheel or turbine, and the pressure or water column engine; several examples of the two latter classes are exhibited: a solitary representative of the vertical wheel is to be found among the collection sent by Messrs. Whitmore and Son.

The horizontal turbine consists of a disc or ring furnished with a series of curved passages or buckets, of rectangular section, through which the water is allowed to flow, after passing through a series of fixed guide curves, coinciding at their mouths with the first element of the curve of the buckets, in order that it may enter the wheel without shock.

There are many different classes of turbine, the chief points of difference being in the arrangement of the buckets and guide curves; the latter are either placed above the wheel or between its axis and the outer circumference: in the wheels known as tangential turbines, and centre vent-wheels, the water is admitted at the circumference and discharged near to the axis of rotation.

A peculiar form of turbine on the central discharge principle, known as Prof. James Thomson's vortex wheel, is exhibited by Messrs. Williamson Brothers; it is intended to develop a mechanical effect of 60 H.P. with a fall of water of 45 feet; it is further illustrated by a working model, together with a pump and fan blower of the same construction. Another turbine is shown by Messrs. Bryan Donkin and Sons, which is distinguished by the improvements introduced in the regulating sluices for varying the amount of water to be admitted on to the wheel.

Mr. Schiele's turbine, exhibited by the North Moor Foundry Company, has the buckets or blades, which resemble the letter < with curved instead of straight sides, arranged radially on the circumference of a cylinder, whose axis may be made either horizontal or vertical; a ring of guide curves, each having an independent regulating sluice, surrounds the wheel; the water is laid on to the apex of the < and is discharged both above and below; the foot spindle instead of being cylindrical is formed according to the solid of revolution generated by a peculiar cycloidal curve, known as Schiele's antifriction curve. From 75 to 81 per cent. of the total mechanical effect of the fall of water employed has been obtained by these wheels in practice. The same wheel may be adapted to be driven by steam power; an example of this modification working a ventilator, is exhibited in motion.

MACHINES FOR RAISING WATER, &c.

Exhibitors.—Appleby Bros. (1783), J. U. Bastier (1792), E. T. Bellhouse (1797), Carrett, Marshall, and Co. (1813), J. and G. Davies (1833), Easton, Amos, and Sons (1844), B. Fowler and Co. (1856), Gerardin and Watson (1860), R. A. Godwin (1862), Gwynne and Co. (1870), Knowelden and Co. (1901), P. La Roche (1905), T. Leadbetter and Co. (1908), T. Middleton (1930), L. Norton (1949), Routledge and Ommanney (1972), C. Ruse (1973), F. Sanders (1980), J. Stone (1995), Thompson and Stather (2006), J. Tylor and Sons (2013), Harvey and Co. (1880).

By reversing the action, that is, by applying power to produce rotatory motion to the axis of a turbine, we obtain a machine capable of imparting velocity and direction to water or other fluids: this principle is exemplified in the centrifugal pumps exhibited by Messrs. Gwynne and Co., and Messrs. Easton and Amos.

Gwynne and Co.'s Patent Centrifugal Pump.—This is essentially of the same construction as the fan-blower; it consists of a vertical fan with curved blades, revolving in a mantle or case furnished with feed pipes from the well, which convey the water on to the fan near to its centre; here the centrifugal motion is imparted by the rapid revolution of the blades, and the water is thrown outward and forced up the rising pipe.

The motive power is furnished by a pair of horizontal high-pressure steam engines, and the water lifted into the upper cistern is discharged in a constant stream, from a height of 2 feet; four smaller pumps are placed at the corners of the lower tank.

Appold's pump, constructed by Messrs. Easton and Amos, resembles a horizontal turbine without guide curves; it is a disc furnished with a ring of buckets on its upper and lower surfaces. The discharge takes place from the inner to the outer circumferences of the rings. This pump has been very largely used in draining low-lying lands, and in other operations necessitating the lifting of large quantities of water through a small height.

A new form of chain-pump, by T. Middleton, driven by a direct acting vertical steam-engine, is placed near Messrs. Gwynne and Co.'s tank; there is also a model of another, by J. U. Bastier, which has been adopted at the mine of Huel Concord, in Devonshire, where there is one at work, raising water from a depth of 110 yards.

The single-acting Cornish engine, used for pumping water, is illustrated by a model of an engine of 100 inches diameter of cylinder, and 11 feet length of stroke, the original of which has been erected at the East London Waterworks, by Messrs. Harvey and Co.; the steam is only used to lift the loaded pump rod; the down stroke is effected by means of the unbalanced weight opposed to the steam piston.

Donkey-pumps for steam-boilers are exhibited in many varieties, by Carrett, Marshall and Co. Hand-pumps by Appleby Brothers, J. Tylor and Sons, and B. Fowler and Co.; while the separate parts of pump work, such as cocks, valves, pump barrels, &c., are distributed over several Classes, having been placed in Machinery, Civil Engineering, and Hardware,

FIRE-ENGINES, HOSE AND BUCKETS, AND FIRE-ESCAPES.

Exhibitors.—Briggs and Starkey (1807), Broughton Copper Co. (1808), T. W. Cross and Co. (1831), E. J. Edwards and Son (1845), Kirkaldy and Sons (1900), Merryweather and Son (1928), Miller and Pierce (1931), W. Roberts (1969), W. Rose (1971), Shand and Mason (1984).

Fire-engines to be worked by hand-power are exhibited by Messrs. Merryweather and Co., Messrs. Shand and Mason, and other makers; they are principally on the model of those used by the London Fire-engine establishment. The number of men required to work them is marked on each one.

Captain Fowke's patent military fire-engine, made by Shand and Mason, has its parts arranged to allow of its being mounted on the carriage of a field-gun, the hose and apparatus being packed on the limber.

Shand and Mason's steam fire-engine is mounted on springs and high wheels, to allow of its being rapidly transported; the steam cylinders and pump barrels are horizontal. This engine is double the power of that constructed for the London Fire-engine establishment.

In the United States Court will be found a steam fire-engine, in which the ordinary force pumps are replaced by a single rotatory pump.

Scattered over the Building will be found all the varieties of ordinary fire engines which are exhibited. In Class X. will be found illustrations of the fire-escapes employed, and the various appliances which have been introduced to facilitale the escape of women, children, the aged and infirm, from houses on fire.

The other articles connected with this Class will be found in close association with the fire-engines.

WATER-PRESSURE CRANES.

Exhibitors.—Sir W. G. Armstrong and Co. (1785).

The pressure engine, or water-column engine, as its name implies, is driven by a column of water acting on a piston moving in a closed cylinder, in a manner analogous to that of a steam-engine; the most prominent illustration of the application of this kind of motor, is furnished by the large-sized working model of a water-pressure crane, by Sir W. G. Armstrong and Co. The load is lifted in this machine by a single acting horizontal engine, the chain being passed over a series of multiplying pulleys, in order that the greatest lift may correspond to the length of stroke in the cylinder; a pair of smaller engines placed under the engine-driver's platform, are employed to turn the crane about its vertical axis. Three small oscillating engines of the same kind, are fitted to work a capstan. In the absence of a natural fall of water, the requisite power for these engines is obtained by means of an arrangement called the accumulator: this is a vertical cylinder containing a heavily-loaded piston, which is lifted by water forced under it by a steam-engine. A large proportion of the power consumed in raising the piston, is given out by its descent, through the medium of the water contained in the cylinder.

HYDRAULIC PRESSES AND LIFTING JACKS.

Exhibitors.—D. Adamson and Co. (1780), Carrett, Marshall and Co. (1813), Huxhams and Brown (1893), Knowelden and Co. (1901), T. Lambert and Sons (1903), T. Leadbetter and Co. (1908), Thompson and Stather (2006), F. O. Ward (2015), Peel, Williams, and Peel (1954), Tangye Brothers and Co. (2002).

The well-known characteristic property possessed by fluids, of transmitting pressure equally in all directions, is applied in the hydraulic press, various forms of which are to be found in the neighbourhood of the centrifugal pumps and sugar mills; among them is one by Messrs. Peel, Williams, and Peel, designed for use in beet-root sugar-making; a compact form is exhibited in a model by Tangye Brothers and Co., of a cotton or wool packing press, having the pumps attached to the lower casting, which contains the cistern, in addition to serving as a foundation.

A press to be used for extracting hops is shown by Messrs. Handyside and Co., it is similar to one made for Messrs. Allsopp and Co., of Burton-on-Trent.

Among the models and drawings exhibited by E. T. Bellhouse and Co., is one showing the manner in which the hydraulic press is arranged, in the machine for making lead pipes.

Small hydraulic presses, worked by hand power, are often used instead of the ordinary screw-jack, for lifting heavy weights, in which case it is usual to employ oil instead of water as the pressing fluid.

An extension of the principle of the hydraulic press is exemplified in a model of a patent crane by Messrs. Carrett, Marshall and Co. The pillar of the crane forms the recipient piston or ram, and is fixed, the cylinder being moveable: by dividing the ram into various chambers, each having a different, superficial area, a series of presses is obtained, which may be either employed separately, or used in combination, and the consumption of water is thus graduated according to the weight to be lifted.

BLOWING ENGINES AND VENTILATORS.

Exhibitors.—J. Howorth (1889), Lilleshall Co. (1910), G. Lloyd (1913), Frictional Gear Company (1953).

The large blowing-engines, exhibited by the Lilleshall Company, are intended for supplying air to blast furnaces for iron smelting; they resemble a pair of ordinary beam steam-engines; the pistons of the steam and blowing cylinders are attached to opposite ends of the beams. In order to equalize the motion, a fly-wheel is added, which is placed between the two engines, on the steam side of the beam. The air is admitted through a series of valves placed in the cylinder covers, and is driven out on the change of the stroke of the piston, into a reservoir of large capacity, from whence it is delivered in a continuous stream, under a uniform pressure, into the furnace.

Howorth's ventilator is intended for ventilating large rooms. A screw is placed on the top of a shaft; this screw is set in motion by the action of the wind on a series of carved projecting blades, and an upward current is therefore established. The air removed by the screw is discharged through openings provided, similar to those in an ordinary chimney cowl.

Among the collection of machines exhibited by the Frictional Gearing Company, as illustrations of the application of their principle of transmission, is one called Davison's Thermantérion, or rapid diffuser of heat: this is a fan-blower surrounded by a hollow spiral tube, through the interior of which a current of steam is made to circulate: when the fan is put in motion, the air passes along the course left for it, between the whorls of the heated spiral, and is thus raised to a high temperature before it leaves the machine.

Other fan-blowers have been already noticed under turbines.

ICE-MAKING MACHINES.

Exhibitors.—H. M. Lawrence and Co. (1906), D. Siebe (1986).

Harrison's ice-making machine, exhibited by Mr. Siebe, is a particular application of the exhausting air-pump; the working of the process is as follows:—A quantity of sulphuric ether, contained in a close vessel surrounded by a current of salt water, is made to pass rapidly into a state of vapour by the action of a large air-pump driven by steam-power: the necessary amount of heat requisite to effect this change in the ether, is abstracted from the surrounding salt-water casing, which is thus cooled to a temperature below the freezing-point of water, and is then made to circulate through a box, containing the water to be frozen, in tin moulds arranged on a travelling frame, which moves in a direction contrary to the refrigerating current. The ether vapour removed at every stroke of the pump is passed over to a condenser, where it reassumes the liquid form, and is returned to the evaporating vessel.

The machine for the same purpose exhibited by H. M.

Lawrence and Co., is in all its general principles similar to that already described.

There is also an ice-making machine exhibited by the French. Ammonia is volatilised by heat, and condensed under its own pressure. By an ingenious arrangement the ammonia vapour is reabsorbed by water, and thus cold sufficiently intense is produced to freeze the water surrounding the condensing vessel. (*See* FRANCE in the Handbook for Foreign Countries.)

SUGAR MILLS AND VACUUM PANS.

Exhibitors.—**Fawcett, Preston and Co. (1850), G. Forrester and Co. (1855), Manlove, Alliott, and Co. (1924), Mirrlees and Tait (1932), W. and A. M'Onie (1921), D. Napier and Son (1938), J. C. Wilson and Co. (2027), D. Cook and Co. (1575).**

These machines form a very marked feature in the Western Annex, from their great size and the ponderous machinery requisite to drive them; they consist essentially of three horizontal iron rollers, having their surface slightly roughened by shallow groovings; they are used for expressing the juice from the sugar canes: three of these mills, those by Fawcett, Preston and Co., W. and A. M'Onie and Co., and Mirrlees and Tait, are driven by massively-constructed beam steam-engines: the total weight of the mill constructed by the last-named firm, is 140 tons, it has a pump attached for lifting the expressed juice, driven by a crank attached to one of the rollers.

A sugar mill of very different proportions is exhibited by J. C. Wilson and Co.; the engine, boiler, and crushing rollers are all contained on one cast-iron bed plate, a form allowing great compactness to be combined with solid construction.

Another apparatus, to be used in the manufacture of sugar, is Bour's evaporator, made by D. Cook and Co., which consists of a series of hollow copper discs, arranged on a tubular axis, through which the exhaust steam from a high-pressure engine is allowed to circulate. The cane juice to be evaporated is contained in a semi-cylindrical trough, through which the discs pass at each revolution of the axis.

A set of air-pumps, driven by a steam-engine, is exhibited by Messrs. G. Forrester and Co.; they are intended to exhaust the air from the three large vacuum pans to which they are attached. The vacuum pan, which was first introduced by Howard, is used by sugar-makers and refiners, in order to effect evaporation of sugar solutions at a low temperature, and thus prevent the waste which is caused by the production of uncrystallizable sugar, when the evaporation is conducted in the open air.

The series exhibited are intended for Prince Halim Pacha, brother to His Highness the Viceroy of Egypt. The filtered cane juice is received in the central pan, where it is evaporated to a certain density, after which it is passed into another pan, where it is further concentrated by means of the vapour formed by the evaporation of the juice in the first pan; and, after leaving this pan, the concentrated juice is filtered through animal charcoal, and finished in the third vacuum or "strike" pan.

Centrifugal sugar machines, for separating the adhering moisture from the sugar, when removed from the crystallizing pan, are exhibited by Manlove, Alliott, and Co., who also exhibit models of washing machines, in which the centrifugal principle is applied to the clothes-drying machine.

OIL MILLS.

Exhibitors.—**M. Samuelson and Co. (1979), Thompson and Stather (2006).**

Messrs. Martin, Samuelson and Co. exhibit the hydraulic presses, and other apparatus, used in the manufacture of oil from linseed, &c., in the Western Annex, among the hydraulic machines. The seed is first bruised between crushing rollers, and is then ground fine under a pair of large stone edge rollers working on an iron bed plate; the finely ground meal, after having been raised to a high temperature in a steam-heater, is transferred to linen bags which are subjected to hydraulic pressure between moulds of ribbed horse-hair cloth. The expressed oil runs down through gutters provided for its reception; the residue forms the well-known oil-cake used for feeding cattle. Another set of presses for the same purpose is furnished by Messrs. Thompson and Stather.

FLOUR MILLS.

This class of machinery is very much scattered: the principal illustration is furnished by Whitmore and Son, in the shape of the arrangement and fittings of two pairs of stones, which are driven by belts from the steam-engine, with the horizontal fly-wheel by the same firm, already noticed.

Examples of millstones and dressing-machines are among the miscellaneous contents of the Eastern Annex.

BREAD AND BISCUIT MACHINERY.

Exhibitors.—**Barrett, Exall, and Andrewes (1554), L. Collier (1573), W. Conisbee (1574), Porter and Co. (1687), G. Stevens (1722), T. and T. Vicars and Co. (1732).**

Bread-making machines are placed in the Eastern Annex: among them is a large biscuit-making machine by Vicars and Co., of Liverpool, and a kneading apparatus for mixing the dough for loaf bread, which has two vertical shafts carrying a series of radial arms spirally arranged, which are made to rotate in opposite directions, producing a combined tearing and screwing action which passes the dough down on one side and up on the other; the trough in which these knives work is made of an oval form. A drawing is added, illustrating the arrangement of a large bread factory.

Another kneading machine, on Stevens's patent, which is made in all sizes, for domestic or manufacturing purposes, is well adapted to replace the severe labour of hand-kneading.

Barrett, Exall and Andrewes have a series of models illustrating Dauglish's patent process for making bread: the dough is formed by mixing flour, with water containing carbonic acid in solution, a process effected in closed vessels under considerable pressure; on removing the dough the raising is effected mechanically, by the escape of the carbonic acid gas; thus rendering the use of yeast or other ferments unnecessary.

The *Patent Aërated Bread Machinery* requires some further description.

The mixer is a cast-iron globe fixed to two side frames, which carry two carbonic acid pumps and a vacuum pump. There are two openings in the mixer, one at the top to admit the flour, and a second for discharging the bread dough; and with this is connected a gas-holder with water-tank capable of holding the requisite quantity of gas for working the machinery, and a generator with agitator, and lead supply acid tank.

The flour, salt, and water are placed in the globe-mixer by the opening at the top of it. The carbonic acid gas and aërated bread is then pumped into the mixer at a high pressure. When the kneading is finished, which is done by a series of mixing arms in the globe, and which operation occupies but a few minutes, a valve is opened at the bottom of the mixer, and the dough is forced out of it by the elasticity of the inside pressure. Here it is received in tins or baskets, and cut off to the size required for the loaves. These tins or baskets are then taken to the ordinary oven, and the bread baked in the usual way.

The advantages of the process may be thus enumerated:—Rapidity in manufacture, occupying about one fifth of the usual time; great cleanliness, none of the material being touched by hand; the prevention of deterioration in the flour; its certainty and uniformity; its production of pure and wholesome bread, and the saving of labour and health to the workmen.

The same exhibitors have also a steam-power biscuit-cutting, stamping, and docking machine. The dough having been reduced to the proper condition by the breaking-down rollers, is brought to this machine and placed on the feeding-table. The rollers that regulate the thickness carry it forward to the endless canvas belt, upon which it travels by the simple action of the machine under the cutters and dockers, at every rise of which a fresh part of the sheet of dough is brought forward, and at the down stroke is cut into the required form. The biscuits being thus formed, docked, and impressed, are carried forward, transferred to the baking-tins, and taken to the oven. These machines can be fitted with any form of cutter required.

LIFTS, JACKS, CRANES, AND HOISTS, DRIVEN BY STEAM, WATER, OR HAND POWER.

Exhibitors.—D. Adamson and Co. (1780), Allen, Harrison and Co. (1782), Sir W. G. Armstrong (1785), Baines and Drake (1788), P. Cameron (1811), Chadburn Brothers (1815), C. S. Dawson (1835), Huxhams and Brown (1803), T. Lambert and Sons (1903), J. Louch and Co. (1914), W. Parkin (1952), Tangye Brothers and Price (2001), J. White (2021), T. Worsdell (2031).

Mr. Ashton's steam hoist, which was employed in lifting all the materials used in the construction of the main building, has been placed in the Western Annex, among the marine engines: it differs from the ordinary crab, having two parallel horizontal barrels placed outside the supporting frame; each of these barrels has its surface divided into a series of grooves, in the hollows of which the fall of the rope travels. Motion is communicated from the driving belt to the drums through a series of spur wheels, geared in such a manner as to cause both to move uniformly.

Messrs. Alex. Chaplin and Co.'s travelling crane has performed service in the Western Annex, equal in importance to that rendered by Ashton's hoist in the main building, for by its assistance nearly the whole of the heavy machinery was brought into place: it consists of an ordinary pillar and jib crane mounted on a railway truck; the overhanging mass of the crane is counterpoised by a vertical boiler with two small inverted cylinder steam-engines attached to it, placed on the opposite side of the central pivot. The engines are provided with special gearing to work either the lifting barrel, or to turn the crane about its centre by an endless screw. A second chain and barrel allows the inclination of the jib to be varied, by which means more horizontal space may be commanded, or a higher lift can be obtained.

An arrangement for lifting weights, known as Weston's patent differential pulley-blocks, is sufficiently popular to find three exhibitors: it consists of a double and single block with two loops of chain connecting them; the upper double block has a double sheaf of two different diameters, with teeth gearing into the chain; the lower block is a plain roller, having a hook to which the weight is hung; as the larger sheaf will take up more chain than the smaller one, when set in motion the weight will be lifted through a height proportional to the difference of the diameters of the toothed sheaves; and as the opposite sides of the chain loop pull against each other on opposite sides of the double sheaf, the weight will remain stationary at any point where it may be on ceasing to pull at the chain.

A steam pile driver, the only representative of its class, by Messrs. Sissons and White, is placed in the large Open Court of the Eastern Annex.

MACHINES EMPLOYING MAGNETS.

Exhibitors.—**F. H. Holmes (1886), H. C. Hurry (1892), D. McCallum (1916), E. C. Shepard (1985), W. Steer (1993).**

The principal object coming under this head is Holme's electric lighthouse lamp: the light is the well-known brilliant one obtained by introducing a pair of charcoal points into the circuit of a powerful electrical machine; it is exhibited as arranged for reflexion by curved silvered mirrors, and for transmission through glass lenses, according to the more improved system introduced by Fresnel. The necessary electrical power is derived from a large ring-shaped battery of one hundred and ninety-six permanent magnets, by a revolving armature wheel passing in front of their poles, driven by a steam-engine. This system of lighting has been tried with success in some of the large lights on the coast of the English Channel.

Close to the lighthouse machinery, the processes of electro gilding and plating are exhibited in action by Mr. M. Lyons; the power employed is derived from permanent magnets in a similar manner to that above described.

An electro-magnetic engine, in the same neighbourhood, does not appear to be sufficiently advanced to allow of its action being examined.

A new method of insulating telegraphic cables is exhibited by Siemens, Halske, and Co.; and models of the machinery used in spinning telegraphic and other wire ropes, by Mr. Archibald Smith. Both of the above will be found near the ice-making machine in the Western Annex.

Messrs. Routledge and Ommaney's magneting machine is a simple and effective contrivance for cleaning brass filings or turnings from particles of iron: this is done by a series of small horse-shoe magnets arranged on a flexible endless frame: the iron filings taken up by the magnets on their passage through the mixed brass filings, are cleaned off by a rotating brush, and delivered into a drawer at the top of the machine.

The *Electro-Magnetic Engine*, by D. McCallum, has some features of novelty.

The new principles shown in this apparatus are two sets of keepers of three each, which are attached to two beams.

These keepers are so arranged that they are apart when the beam of the engine is raised, and brought closely together when the beam is down. The object of this is to lengthen the stroke, for the length of stroke will be in proportion to the number of keepers. The main beam is like that of an ordinary steam-engine. The second beam is only half the length of the other, and moves on a centre from the fulcrum of the first, and falls on it as the stroke is being made downwards. As the second beam falls, it draws down the first, and thus converts itself into a full-length beam at every stroke.

One electro-magnet is placed under each set of keepers, and they are so arranged, that as the one set is brought down, the other set is in full operation. A fly-wheel is attached, which by its revolutions makes and breaks contact in either direction by a peculiar arrangement not easily described without the aid of a diagram.

BREWERY MACHINES AND COOLERS.

Exhibitors.—C. Askew (1787), H. Bridle (1806), J. Lawrence (1907), G. Riley (1967), W. L. Tizard (2008), Handyside and Co. (1874).

It is not possible to describe the several plans which are introduced to facilitate the extraction of saccharine matter from the malt—to aid the process of fermentation—or to accelerate the cooling of the wort. The coolers are, many of them, exceedingly ingenious—the principal being to expose the largest possible quantity of the warm surface to cooling influences.

The simplest mode of refrigeration is by exposing the hot liquor or wort in shallow vessels, called coolers, to the action of the atmosphere or a current of air, sometimes accelerated by fans rotating horizontally just above the surface of the liquor; but sometimes utensils called refrigerators are employed, and so constructed that a quantity of cold water should be brought into contact with the heated fluid.

A simple form of refrigerator is that of the worm used by distillers; and the reverse process is commonly used by brewers, viz., a stream of cold water passing through pipes in a zigzag form, laid horizontally in the shallow cooler. But in every construction of refrigerator heretofore used, the quantity of cold water necessarily employed in the operation, greatly exceeded the quantity of the fluid cooled, which, in some situations, where water cannot be readily obtained, was a serious impediment and objection to the use of such apparatus.

APPARATUS FOR OBTAINING FRESH WATER FROM SEA WATER.

Exhibitors.—Normandy and Co. (1946).

This apparatus has been supplied to a large number of the emigrant ships; and the reports of the emigrant commissioners show that excellent water is obtained by this method from the salt water of the ocean.

From Dr. Normandy's pamphlet a few brief notes may be taken, describing the principles and mode of operation.

When ordinary water, whether fresh or salt, is submitted to distillation, the condensed steam, instead of being, as might be supposed, pure, tasteless, and odourless, yields on the contrary a liquid free from salt, it is true, but of an intolerably nauseous and empyreumatic taste and odour which it retains for many weeks; it is, moreover, insipid, and vapid, owing to its want of oxygen and carbonic acid, which water in its natural state possesses, and of which it has been deprived by the process of distillation. In the absence of ordinary fresh water, this distilled water, however disagreeable and objectionable it may be, is of course of use so far as it is fresh, but the crews invariably refuse it as long as they can obtain a supply from natural sources, even though this may be of so bad a quality as to endanger their health.

It is known that the sea and other natural waters are saturated with air containing a larger proportion of oxygen and of carbonic acid than the air we breathe. In effect, 100 volumes of the air held in solution in water contain from 32 to 33 volumes of oxygen, whereas 100 volumes of ordinary atmospheric air contain only 24 volumes of oxygen. Again, ordinary atmospheric air contains only $\frac{1}{1000}$ of carbonic acid, whereas the air held in solution in water contains from 40 to 42 per cent. of carbonic acid. The experiments which I undertook in 1849-50, with a view to determine the amount of these gases present in water, showed me that this amount varied with the state of purity of the water; that whilst ordinary rain-water contains, on an average, 15 cubic inches of oxygenised air per gallon constituted as follows:—

Carbonic acid	6·26
Oxygen	5·04
Nitrogen	3·70
	15·00;

sea water, owing to the various substances which it holds in solution, contains only on an average 5 cubic inches of gases, more than one half of which is carbonic acid; or, in other words, one gallon of sea water contains about two-thirds less gases than ordinary rain water, and one half less gases than river water.

I have also ascertained that air begins to be expelled from such natural waters when the temperature reaches about 130° Fahr.; and we know that when the temperature reaches 212° Fahr., all the air which it contained has been expelled, and it is for this reason that distilled water contains no air.

Dr. Normandy's apparatus consists of three principal parts, an evaporator, a condenser, and a refrigerator, joined so as to form one compact and solid mass, screwed and bolted, without soldering or brazing of any kind. The evaparator is a cylinder, partly filled with sea-water, into which a sheaf of pipes are immersed, so that on admitting steam at a certain pressure into these pipes it is condensed into fresh, though non-aërated water, by the sea water, by which the pipes are surrounded, that sea water being thus heated and a portion of it evaporated at the same time; for it is one of the properties of steam to be condensed by water, no matter how high the temperature of that water may be, if it be only inferior to that of the steam. This non-aërated water, becomes aërated, as I shall explain presently:—On board steamers, the steam is obtained directly from the boilers of the ship; in sailing vessels it is procured from a small boiler which may, or may not be connected with the hearth, galley, or caboose.

The steam at a pressure being, of course, hotter than ordinary boiling water, serves to convert a portion of the water contained in the evaporator into ordinary or no-pressure steam, which, as it reaches the pipes in the condenser, is resolved therein into fresh aërated water. By thus evaporating water under slight pressure, one fire performs double duty, and thus the first condition, that of economy, is completely fulfilled, for while in the usual way, 1 lb. of coal evaporates at most 6 or 7 lbs of water, the same quantity of coals, burnt under the same boiler, but in connection with my apparatus, is thus made to evaporate 12 or 14 lbs. of water, or, in other words, from the same amount of coals or of steam employed, the machine which I am describing will produce double the quantity of fresh water that can be obtained by simple or ordinary distillation; that is to say, double the quantitity obtained by the ordinary condensers.

I found by experiments, performed on a somewhat extensive scale for many months, that two cubic feet of charcoal are sufficient to remove entirely the empyreumatic odour and taste of distilled water, produced at the rate of 500 gallons per diem, and that the charcoal *never wants renewing*, because it does not act as a *filter*, but as a *fire grate*, the substance burnt being the empyreumatic product, and the result of the slow combustion thereof being the ordinary products of combustion, to wit, carbonic acid and water. I have every reason to believe, from the length of time during which several of my apparatus have been in operation, both on board a large number of ships and on land, that such a filter once made will last for ever, because the charcoal disinfects the water, so to speak, as it does air, not by mechanical separation, but by actual, though insensible combustion. The water as it issues from the apparatus is perfectly sweet, tasteless, inodorous, and saturated with its proper and normal quantity of oxygenised air and carbonic acid; it is of sparkling clearness, and being refrigerated in traversing the sheaf of pipes of the refrigerator, surrounded by cold sea water at the lower part of the apparatus, it is fit for immediate use.

AUTOMATON MINT WEIGHING-MACHINE.

Exhibitors.—**D. Napier and Son** (1938).

The mechanical adaptation of the principles involved in the Automaton Balance, as contrived by Mr. Napier, may be shortly explained:—The weighing beam, of steel, is forked at the ends, each extremity forming a knife-edge; and in the centre the fulcrum knife-edge extends on each side of the plate of the beam, and rests in hollows cut in a bowed cross-bar fixed to the under side of a rectangular brass plate, about 12 inches square, which is supported at the corners by columns fixed to a cast-iron table raised a convenient height on a stand of the same metal. To form a complete enclosing case, plates of metal or glass are slid into grooves down the columns. When the beam is resting with its centre knife-edge in the hollows of the cross-bar just referred to, its upper part is nearly on a level with the under-side of the brass plate, in which a long slot is made, so that the beam can be taken out when the feeding slide-box, and its plate, which covers this slot, are removed. On the top of the covering plate of the feeding slide a tube hopper is placed, and a hole in the plate communicates with the slide; another hole is pierced in the same plate exactly over one end of the beam, upon the knife-edges of which a long rod is suspended by hollows formed in a cross-bar close to its upper end, where the weighing platform is fitted. A rod is also suspended at the other end of the beam in a similar manner; but instead of a weighing plate, it has a knob at top, which, when the beam is horizontal, comes into contact with an adjustable agate point. The lower end of this pendant rod is stirrup-shaped, for holding the counterpoise. Two displacing slides are provided, one on each side of the feeding slide, and at right angles to each other; and a gripping apparatus is fixed to the under side of the brass top plate, arranged so as to hold the pendant on which the scale-plate is fitted during the change of the coin. A dipping finger is also attached to the frame of the gripping apparatus, its end passing into a small slot in the pendant rod, and acting upon a knife-edge at the lower end of the slot. There are four shafts crossing the machine; the one through which the power is applied is placed low and at the centre, and carries a pinion which gears with a wheel of twice its diameter on a shaft above; this wheel gears with two similar wheels fixed to shafts on each side of the centre. Cams for acting upon the feeding slide, through the medium of a rocking frame, are carried by the shaft, placed at the end of the machine where the counterpoise hangs, and the other two shafts on the same level bear cams for working the gripping apparatus, the dipping finger, and the displacing slides.

BOTTLING AND CORKING MACHINES.

Exhibitors.—J. Bate and Co. (1793), Farrow and Jackson (1849), J. Gallagher (1858), R. H. Macord (1922).

Towards the upper or northern end of the Eastern Annex will be found a miscellaneous assortment of articles, which may be conveniently included under one head.

Brewers' refrigerators form a principal portion of this group; they may, in general terms, be said to resemble the surface condensors of marine engines; the refrigerating water is made to circulate through the interior of a series of coiled or straight tubes, immersed in a vessel kept filled with the liquor to be cooled.

Bottling and corking machines find several exhibitors; full particulars of the improvements noticeable are generally to be found attached to each machine.

WASHING MACHINES.

Exhibitors.—T. Bradford (1804), Briggs and Starkey (1807), J. Chedgey (1820), W. Hargreaves (1875), R. Lansdale (1904), W. McFarlane (1907), W. Summerscales and Sons (2000), E. Weir (2018) W. Williamson (2025).

Various kinds of washing-machines, in which the operations of hand-washing are imitated by rotating tubs, moving about one or more axes, oscillating beater frames, stamping or pounding by stampers, and other methods, form a large group in this part of the building: the diversified nature of the combinations employed indicates the importance and popularity of this particular class of machinery. In the smaller sizes, applicable for domestic use, it is customary to combine the washing-machine with a pair of wooden rollers, which can be used for both wringing and mangling with very slight modification. This is the case with the washing, wringing, and mangling machine, of Mr. Weir. In this machine the clothes are washed by a rocking motion being given to the machine, causing the clothes to be rubbed against the sides and bottom, which is so formed as to apply a sort of rubbing motion to them, and against each other, which is found to be the best motion for cleansing them. The machine has large rollers for wringing and mangling.

Mangles are exhibited of several forms. McFarlane's is a good mangle, and possesses the recommendation that it is easily fitted up, removed, or repaired. The pressure is regulated with such precision that a weight of from ten to twenty hundredweight can be laid off or on by a single turn of the hand.

The limits of this book will not allow of entering into any further description of machines which are much used, and by many recommended.

LEATHER-SCRAPING AND ROLLING MACHINES.

Exhibitors.—Stothert and Pitt (1724), J. Vere (1731).

Two new machines for dressing hides and leather are exhibited by Messrs. Stothert and Pitt: the first is intended for scraping the surface of hides, by means of a spiral knife arranged on the surface of an horizontal cylinder; the hide is pressed against the knife by a similar cylinder, mounted on spring bearings, to allow the pressure to be kept uniform when the hide varies in thickness. The other machine is intended for polishing the surfaces of dressed hides. It has a loaded horizontal roller, which is propelled backwards and forwards by a direct-acting horizontal steam-engine, having the slide motion arranged so as to allow the length of stroke of the piston to be altered while in motion.

FLY-PRESSES, EMBOSSING MACHINES, COPYING PRESSES, &c.

Exhibitors.—J. Clark (1568), D. and J. Greig (1611), J. Morison and Co. (1664), R. C. Newbury and Co. (1674), R. Roberts and Co. (1694), J. Tidcombe and Sons (1729), E. and W. Ullmer (1730), R. Burn (1565), Deane and Davies (1583), Hawkins and Co. (1617), H. Hughes 1623), G. Jarrett (1631), W. Jones (1635), D. Napier and Sons (1669), F. Preston and Co. (1690), T. R. Pinches and Co. (1686).

The process of striking medals is exhibited by Messrs. Pinches and Co., in the Process Court, who employ the ordinary screw fly-press, driven by hand-power. A fly-press of a similar character, but which is arranged to be worked by steam-power, is to be found in the Western Annex, among the steam-hammers.

Small lever presses, for embossing note paper, envelopes, and similar small articles, are exhibited in the Process Court.

Numbering, paging, and ruling machines, are exhibited by Clark, Craig and Sons, and H. R. Palmer.

Engraving machines by Garside, J. Naylor, J. Lockett and Co., and by J. Wright. The most interesting of these is the electrograph engraving machine described at page 254.

CRUSHING MACHINES.

Exhibitors.—T. Carr (1812), H. T. Balfour (1789), R. Edwards (1846), W. Herkless (1883), Huxham and Brown (1893), T. Neale (1940), R. Gibbon (1861).

The greatest novelty among the crushing machines exhibited, is Carr's disintegrator, which is placed in the Eastern Annex. This machine, intended for grinding phosphates or other hard materials, is formed of a series of four cylindrical iron cages arranged one within the other on an horizontal axis, in such a manner, that the first and third cages are made to travel in a direction opposed to that of the second and fourth. The material to be ground is placed in the central cage, in the state of rough lumps, and is rapidly delivered from the outer one in a coarsely grained powder.

From thirty to forty tons of a moderately hard material, can be ground in one machine, per diem.

MISCELLANEOUS.

Amongst the numerous objects which group themselves under this head, and which merit a more particular description than can possibly be afforded to them, may be named the following:—

W. H. Kingston's method of communicating between the passengers and guard.

Kennan and Sons exhibit a sculpture machine, invented by Chas. Shaw, Esq., which is capable of copying works of art from the *round or relief*, upon either an increased or diminished scale, in ivory, hard wood, or alabaster. It is worked by one man; provision is made for operating upon every variety of surface; and the arrangement for a proportional movement of the copy and original in right lines, is believed to be quite unique. A horse and serpent executed in ivory is exhibited, as illustrating the peculiar powers of this machine. The same firm exhibits some good turning lathes.

Driving Belts for more than twenty engines now working in the Western Annex, and for the French pumps which convey the water for the fountains in the Horticultural Gardens, are supplied by the North British Rubber Company, who are the manufacturers of Parmelee's patent india-rubber belting.

The advantages which this "Patent Belting" possesses over any others are, that, when properly used, it does not stretch, working equally under water or in warm positions, neither stretching under the former, nor softening or drying hard under the latter circumstances. It does not slip, and from its perfect uniformity of surface and thickness, its grip on the pulleys is a great gain of power. For open belts it is unsurpassed, and by numbers of large firms it is used crossed with great success. Its strength is one of its chief recommendations. From its being made of Sea Island cotton of the longest staple, and woven in a peculiar manner, so as to give the greater strength to the warp, when united with layers of india-rubber it becomes a fabric of immense strength, and is capable of doing an amount of work which leather or other fabrics could not stand.—See Classes IV. and XXVII.

The well-known chain of buckets, which has been employed in the East for irrigating purposes from time immemorial, has received a new application at the hands of Mr. G. Zanni, who has contrived a self-acting basting-machine. A small chain of buckets, driven by the clock motion of the jack, lifts the melted grease into a slightly inclined trough, whence it is distributed over the object to be basted.

Two contrivances for facilitating the labour of boot-cleaning are shown: one is a metal boot-tread fixed to a wall by an iron standard, the other is a rotatory brush driven by a crank and treadle.

Coffee-mills, and other small crushing machines, are placed at the top of the Annex; opposite to them will be found beer-engines, and other tavern fittings.

In addition to those we have *horse-hair dressing and curling*, with *brush-cutting* machines, and others for *assorting bristles* and *separating cow fibre.*

Hunt and Roskell exhibit the process of *diamond cutting*, and Sharratt and Newth that of *polishing* and *setting glazier's diamonds.*

Several machines used in trade, as for tobacco-cutting, cinnamon-cutting, and the like, are in this crowded Annex.

The machinery belonging to Foreign countries will be described in the division of the *Handbook* devoted to their collections.

SEWING MACHINES.

(See page 254.)

Sewing-machines are divided into four classes, determined by the kind of stitch they produce.

Under the first class come the machines which make a stitch in imitation of handwork, the needle passing completely through the stuff. The first patent sewing-machine was arranged so as to push a common needle through the stuff and pull it out on the other side, by Thomas Stone and James Henderson, in France, 1804, but their scheme was abortive.

Other patents following the same device have been taken from time to time at long intervals, but the machine proved slower in operation than the hand, and this mode of creating a mechanical stitcher has always proved unsuccessful, as an embroidering machine. In 1834, M. Heilmann exhibited at Paris his admirable embroidering machine which worked about one hundred-and-fifty needles at the same time, and embroidered each the same flower, on a piece of silk stretched in a frame, and guided by a pantograph. Although the operation is a very slow one it is compensated for by the number of needles at work. The needle (which was pushed through one side and pulled through on the other side of the stuff) was made with a point at each end and the eye in the middle, so as to avoid the necessity of turning it after each passage. Heilmann's machine, although unsuccessful in France was well received in Manchester, and is still in use. Mr. Houldsworth made a variety of improvements in this machine (and it formed one of the most attractive objects of the Exposition of 1855), for which he received a first-class medal. Barbe Schmitz, of Nantz, exhibited an ingenious attempt to construct an embroidering machine for the same purpose as Heilmann's, but although some of the arrangements were very complete, and great ingenuity was shown in the contrivances, it was not in a working state.

Under the second class are the machines which form a stitch known as chain-stitch or "crochet." This is wrought by a needle which terminates by a hook; the needle is grasped at the other end, and the hook pushed through the stuff which catches hold of a thread below, and then being withdrawn, brings with it a small loop; the hook retains the loop, and repassing through the stuff at a little distance, catches a new loop and is again withdrawn, and so on. The first sewing-machine for this stitch was invented by M. Thimonnier, and patented in France, 17th July, 1830; and again with improvements, 5th August, 1848, in association with M. Magnin: when exhibited in 1855 it worked at the rate of three hundred stitches per minute, and in its present state is therefore too slow to compete with the American machines. This patent was introduced into England in 1848, and into America in 1849.

Morey and Johnson patented a sewing-machine for chain-stitch (in 1849, Feb. 6.), which is remarkable for excellent workmanship, and for ingenious devices: it can be worked without any risk of failure at the rate of five hundred stitches per minute.

The third-class machines are those by which the stitch is produced by two threads: in America it bears the name of mail-bag stitch, but is now most commonly known as shuttle-stitch. One of the threads is carried by a small shuttle under the cloth, and the other by a vertical needle which has its eye very near the point which pierces the cloth, forms a loop of the thread through which the shuttle passes; the needle rises but the loop is retained by the shuttle-thread. The first machine of this description was invented by Walter Hurst, of New York, in 1834, but the first did not produce good work; but in Sept. 10, 1846, Elias Howe patented a machine on the same principle, which has turned out to be exceedingly practical.

The fourth-class sewing-machines produce more complete stitches than the former. These are formed by two threads which mutually interlace each other in chain stitches so as to avoid the unravelling to which the simple chain-stitch is subject; and there is no need of stopping at short intervals to supply fresh bobbins as in the shuttle-stitch machines. The two earliest machines of this description were patented by Grover and Baker in America, 1851 and 1852; and by Avery at the latter end of 1852.

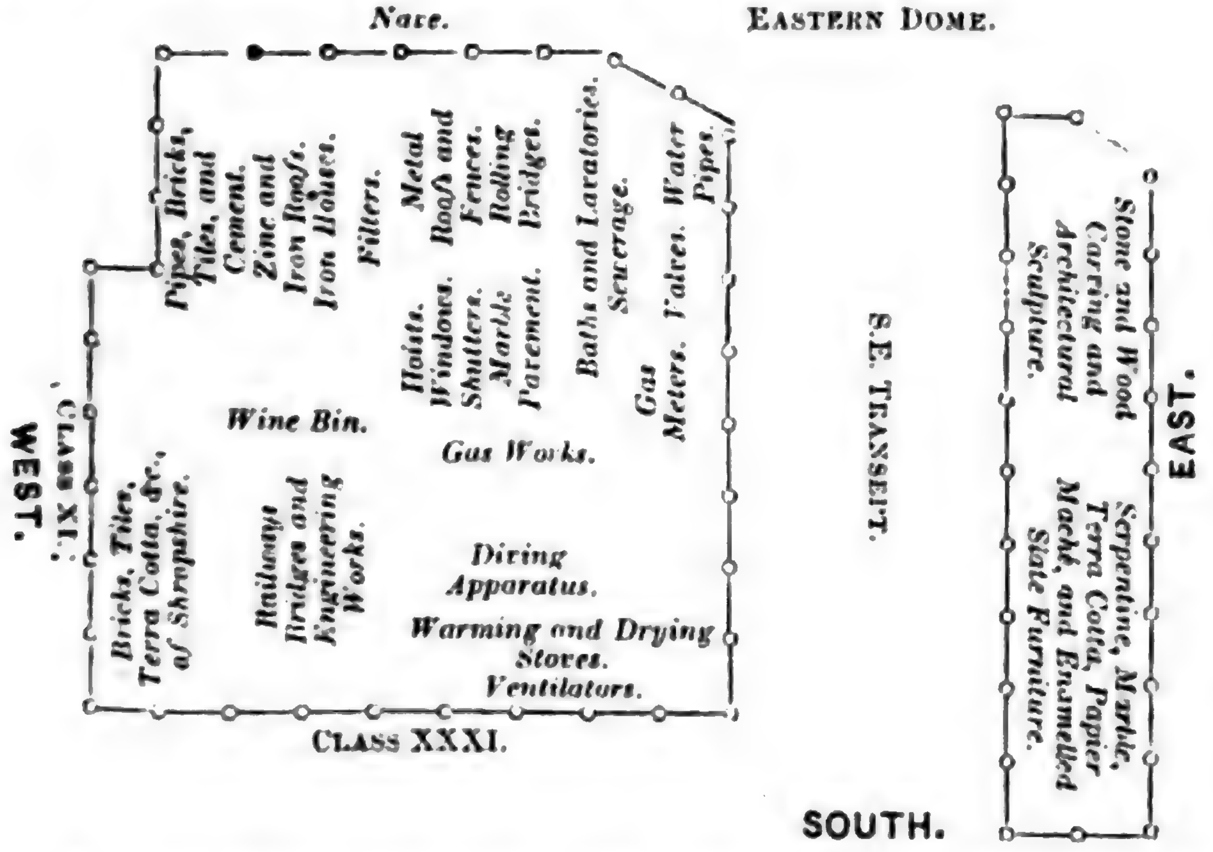
All the most important American patents have been repatented in England and in France, and the use of them appears to be slowly and gradually extending itself; and there is no doubt but that in time its imperfections will be if possible gradually removed; and it may take its place in the series of manufacturing mechanism as a most useful agent.

CLASS X.—CIVIL ENGINEERING, ARCHITECTURAL, AND BUILDING CONTRIVANCES.

Number of Exhibitors, 211.

SITUATION OF CLASS.—*This Class occupies the space entered from the south-west corner of the Dais under the Eastern Dome; it extends eastward along the Nave and southward along the Eastern Transept. Another division of this Class will be found on the Eastern side of the Transept.*

Position of Groups.—Immediately at the corner nearest the Dome are gas-meters, valves, water-pipes, and sanitary arrangements. Along the side nearest the Nave, bridges, metal roofs, iron house, and bricks and tiles. Extending from the Transept will be found ventilating and drying apparatus. In the centre of the Court are models and engineering works, terra cotta works being at the corner nearest the Hardware Class. On the Eastern side of the Transept are Architectural carvings and sculpture, Serpentine, marble, terra cotta, and enamelled slate.


Nave.
EASTERN DOME.
Pipes, Bricks, Tiles, and Cement.
Zinc and Iron Roofs. Iron Houses.
Filters.
Metal Roofs and Fences. Rolling Bridges.
Baths and Lavatories. Sewerage.
Water Pipes.
Hoists. Windows. Shutters. Marble Pavement.
Gas Meters. Valves.
Wine Bin.
Gas Works.
CLASS XI.
WEST.
Bricks, Tiles, Terra Cotta, &c., of Shropshire.
Railways Bridges and Engineering Works.
Diving Apparatus.
Warming and Drying Stoves. Ventilators.
CLASS XXXI.
S.E. TRANSEPT.
Stone and Wood Carving and Architectural Sculpture.
Serpentine, Marble, Terra Cotta, Papier Maché, and Enamelled Slate Furniture.
EAST.
SOUTH.

It will be seen from the plan that the Class is arranged in two divisions, one being on the Eastern side of the South-eastern Transept, and containing only ornamental objects in stone, marble, &c., while the remainder are to be found in a large Court on the opposite side, at the angle of the Nave and S.E. Transept. This second Court is further divided by screens, two smaller Courts being formed for models of bridges, &c., and a joint exhibition of the ornamental clay manufactures produced in Shropshire, in the neighbourhood of Coalbrook Dale. An elaborate pavement, in marble mosaic, designed by Mr. Slater, for the choir of Chichester Cathedral, is the only ornamental work placed among the articles of utility in the largest Court.

RAILWAYS.

Exhibitors.—Charles Vignoles (2354), J. Chalmers (2250), W. Turner and J. W. Gibson (2352).

One of the most striking objects in the Exhibition is in this Court. It is a model of that portion of the Tudela and Bilbao railway, which has been constructed by Mr. Vignoles across the great chain of the Cantabrian Pyrenees, lying between the Bay of Biscay and the valley of the river Ebro.

The whole length of this line of railway is nearly one hundred and sixty miles; viz., from the port of Bilbao, on the north coast of Spain, to a point between the towns of Alfaro and Tudela, on the river Ebro, from whence other railways branch south to Madrid, east (by Zaragoza) to Barcelona, and north to Pamplona.

The dimensions which this model occupies upon the floor of the Exhibition are 20⅓ feet in length by 12 feet in breadth; that is an area of nearly 250 square feet.

The *horizontal* scale of the model is $\frac{1}{5000}$; *i. e.*, 416⅔ feet to an inch, or about 12⅔ inches to a mile. This is the smallest scale on which the topography, &c., can be properly shown. To bring out the mountains and ravines effectually, the *vertical* scale of the model is $\frac{1}{2000}$, that is, 166⅔ feet to an inch.

This passage of a line through the Cantabrian Pyrenees, as shown on the model, is that of the first railway carried into operation ENTIRELY THROUGH either of the two greatest mountain ranges of Southern Europe; exhibiting the latest progressive steps in civil engineering, by one of the most difficult railway undertakings hitherto realized.

The extent of railway shown on the model is 36 miles, including all the windings of the line along the skirts of the mountains. Nearly 220 square miles of the features of the Cantabrian chain have been delineated from triangulations, measurements, spirit-levelling, contouring, and barometrical observations made for this special purpose; and the topographical, geological, and engineering details are duly shown.

The level of the summit which the railway pierces is 2,163 feet above the sea, being probably the lowest pass in the whole Pyreneean range. Some of the peaks and tops closely adjacent to the line are from 3,000 to 4,000 feet above the sea-level. Most of the scarps and ravines are very steep, and in places from 500 to 700 feet face of perpendicular rock, with two waterfalls of those heights respectively.

A rising gradient for nearly 40 miles, averaging 1 in 100, surmounts the ascent from the port of Bilbao to the summit; but the great rise from the east side of the valley or basin of Orduña is 1 in 70 (shown on the model); and for intervals equal to more than half the length of this long incline of 12 miles, the railway is on reversing curves, principally of about 307 yards radius only. Two points on the line, at the entrance of the Orduña basin, 600 yards apart, measured across the gorge, are 8½ miles distant from each other in travelling along the railway, with 456 feet of difference in level. As a necessary consequence, such a line has only been obtained by heavy works of excavations, embankments, tunnels, and viaducts.

It will only be doing justice to the spirit of enterprise and sound commercial principles displayed by the merchants and citizens of Bilbao, some few of the inhabitants of one or two of the chief towns on the line of railway, and certain of their fellow-countrymen and correspondents in the Havana and in England, to state that they are the chief, probably the only subscribers to this great work, aided by a subvention from the Spanish Government.

The contract for the line from Bilbao through the mountains to Miranda on the Ebro, a length of about 70 English miles, is in the hands of the well-known parties, Brassey, Peto & Co., of London.

The locomotive engines for working this remarkable line are built by Messrs. W. Fairbairn and Sons, and by Messrs. Beyer, Peacock and Co., of Manchester. They will carry a load of 100 tons at a velocity of 16 miles an hour up the above-mentioned inclined plane. The carriages and waggons have been supplied from Ashbury's establishment at Openshaw, near Manchester.

A further interest attaches to this model, as it includes some of the stations selected by the most eminent English and foreign astronomers, for observing the phenomena of the total eclipse of the sun, which occurred in the month of July, 1860. Above Orduña, Dr. Whewell, the Master of Trinity, made his physical observations of the phenomena. In Pobes and its vicinity, Airy, the Astronomer Royal of England, and Struvé, the Imperial Astronomer from Russia, with assistants from Portugal and Germany, observed the eclipse; and further down, at Riba-Bellosa, Mr. De la Rue succeeded in his photographs of the phases, as the moon passed across the sun's disc; for which and other great successes in celestial photography, Mr. De la Rue received, in 1862, the gold medal of the Royal Astronomical Society.

These Photographs will be described when Class XIV. comes under consideration.

ENGLISH CHANNEL RAILWAY.

Mr. James Chalmers exhibits a large sectional drawing of a proposed railway under the English channel. The rails are laid in a circular wrought-iron tube divided by a central wall resting on the bed of the channel. The gradients vary from 1 in 150 to 1 in 550, and a central ventilating shaft is proposed, rising above the surface of the water in mid-channel. The tube is represented as laid in a protecting embankment of loose stone, and has an internal valve dividing the tunnel into two parts, through each of which a line of rails passes. Another modification represents the tube without any internal divisions, and strengthened by an interior casing of brick, for the purpose of dispensing with the external stone casing.

Another plan for the construction of tubular submarine railways, by Messrs. Turner and Gibson, is represented by a small model of a metal tunnel of an elliptical section.

BRIDGES.

Exhibitors.—**J. Brunel (2245), J. E. Errington (2277), Gibson and Turner (2289), Gilkes, Wilson, and Co. (2290), J. Hawkshaw and W. H. Barlow (2295), Lieut.-Col. Kennedy (2307), Sir J. Macneill (2316), B. Peld (2329), S. J. Pillar (2331), A. Sedley (No Number).**

Models of the bridges crossing the River Wye at Chepstow, and the Tamar at Saltash, are exhibited by Mr. Brunel. The Chepstow bridge, on the South Wales line, is constructed for a double line of railway, and consists of three side spans of 100 feet each, and one principal span over the river of 300 feet opening. The piers consist of hollow cylinders of cast-iron, 6 feet in diameter, filled with concrete. Each roadway over the river opening is carried between a pair of girders of similar construction 300 feet long, which are supported at the extremities by the piers, and at four intermediate points, two at 12 feet and two at sixty feet from the centre, where they are attached to two sets of suspension chains, which form the tensional part of a pair of rigid trusses. In these trusses the tension delivered by the suspension-chains is received by a straight tube of plate-iron of circular section, 9 feet in diameter, which is supported at its extremities on a framing fixed above the piers at a height of 50 feet above the rails, and at two intermediate points by vertical struts raised from the suspension chains at the points 60 feet from the centre of the span, where the girders are attached to them. Rigidity is given to the structure by diagonal chains extending from the top of each strut to the foot of the other. The weight of iron in each of the main spans is 460 tons. The western end of the main spans is supported on a pier formed of six cast-iron cylinders, which are driven down to the solid rock at a depth of 8 feet below high-water level.

The viaduct at Saltash carries the Cornwall railway, a single line, across the river Tamar. It consists of two spans of 455 feet each, over the river, and 17 land opening—10 on the Cornwall and 7 on the Devonshire side, of varying spans from 70 to 90 feet each. The girders of the main spans are supported by trusses analogous to those used at Chepstow, but having the tubes which resist the tension of the suspension chains, of an elliptical instead of a circular section, and they are arched in the direction of their length instead of being straight, the rise of the arch being equal to the drop of the suspension chains. The roadway and girders are supported equally by the tubes and suspension chains, the girders being carried by vertical struts placed at intervals of 40 feet, diagonally braced, so as to give rigidity, and by intermediate attachments to the chains. The weight of iron in each truss is 1070 tons. The substructure of the central pier consists of a granite pillar 35 feet in diameter, built up from the rock 86 feet below high water mark to a height of 10 feet above it, from which rise four hollow octagonal columns of cast-iron, built up in segments bolted together internally, and which carry the girders on an entablature placed above their capitals. The lower part of this pier, which was the chief difficulty in the construction of the work, was built in a coffer-dam or cylinder of plate-iron 37 feet in diameter and 90 feet in length, closed at the top, and having its bottom divided into compartments, which were kept clear of water, partly by a supply of compressed air, partly by pumping. This cylinder was correctly placed on the rock through a covering of 13 feet of mud, and being loaded with shingle ballast, it assisted to keep out the water. The trusses were built on the Devonshire shore, were floated to their places on pontoons, and were afterwards raised by hydraulic presses. The height of the rails is 100 feet above high-water mark.

Messrs. Hawkshaw and Barlow's model represents the plan proposed for the completion of the bridge over the gorge of the Avon, at Clifton, near Bristol. It consists of a single span bar chain bridge, of 703 feet distance between the piers. The chains supporting the roadway are each formed of three sets of flat bar chains placed one above another. The height of the roadway above the river is 260 feet.

Sir John Macneill contributes a model of the Boyne viaduct, near Drogheda, on the line of the Dublin and Belfast Junction Railway, in which the lattice girder principle is applied on a large scale. The total length of this bridge is 1750 feet, part of which is formed of semicircular stone arches of 60 feet span; but the river is crossed at a height of 90 feet from the water, by three spans of deep lattice girders of wrought-iron, which are united by transverse girders of a similar character into a kind of skeleton tube, through the interior of which the roadway is carried. The span of the central opening is 264 feet; the two side ones are 138 ft. 8 in. each. The total weight of ironwork in the girders, for both lines of rails, does not exceed 700 tons.

Mr. Bouch's bridge, carrying the South Durham and Lancashire Union railway over the valley of the Beelah river, in Westmoreland, is illustrated by a model of one span, and a photograph of the finished work, exhibited by Messrs. Gilkes, Wilson, and Co., the contractors. It is of an iron trellis construction, supported on tapering piers of open work, formed of cast-iron columns. The whole structure, which is 1,000 feet long and 200 feet high in the centre, was erected in four months. A drawing of one of the largest bridges of this class, namely, the Crumlin viadact on the West Midland railway, may be seen in the immediate vicinity of this model, in the ornamental iron summer-house, shown by Messrs. Kennard and Co., in Class XXXI.

Lieut.-Col. Kennedy exhibits a model of the bridges adopted on the Bombay, Baroda, and Central India railway, for crossing the numerous rivers occurring on the line. The system of construction of the roadway resembles that adopted in the two preceding examples. The piers are formed of hollow cast-iron columns bolted together, and supported on screw-piles. In addition to the model, these works are illustrated by a drawing showing the disposition of the piers in the various bridges on the line. A standard width of span of from 60 to 80 feet is adopted.

A collection of drawings and diagrams by the same exhibitor gives an interesting view of the nature of the passenger traffic on Indian railways, the chief feature being the enormous number of passengers required to be carried in each train.

Mr. Angelo Sedley exhibits a model of a new system of a combined tubular and chain suspended bridge, which it is proposed to adopt for spans far in excess of any at present in use. This plan is said to be available up to 1,500 feet width of span.

Mr. J. E. Errington's model of the viaduct across the Lune valley is the only one in the Exhibition in which the arched form of metallic construction is employed. It consists of a central iron arch of 120 feet span, with smaller arches of masonry spanning the valley on either side.

Messrs. Gibson and Turner exhibit a model of a moveable wrought-iron girder bridge, supported on rollers, adapted for carrying railways or roads at a low level over navigable watercourses; and Mr. J. S. Pillar's models represent two truss bridges, of a pattern employed on the railways of the United States of America.

METROPOLITAN MAIN DRAINAGE.

Exhibitor.—**J. W. Bazalgette (2369).**

The works now in process of construction for the metropolitan main drainage are largely illustrated by the collection contributed by Mr. Bazalgette, which includes a complete set of the specifications and contract drawings, a portion of the arch of one of the sewers of the full size, in brickwork, and models showing the methods adopted in carrying the sewers across the Eastern Counties railway and the river Lea, by means of bridges or aqueducts.

HARBOURS AND GRAVING DOCKS.

Exhibitors.—**E. Clark (2255), W. Cory and Son (2262), R. W. Jackson (2303), W. Hartlepool Harbour Co. (2410), G. Rennie and Son (2334), Tod and MacGregor (2350), Lawrence Brothers (2310).**

A model of the hydraulic lift, invented by Mr. Edwin Clark for the use of the Thames Graving Dock Company, claims precedence in this section from its beauty and importance.

The system is entirely novel, and differs from an ordinary graving dock in that, instead of the vessel being floated into a pit and the water pumped out, or allowed to run out with the tide, the vessel is bodily raised out of the water, cradled upon a shallow pontoon, on which it is afterwards floated away to any place convenient for its repair. The apparatus for these enormous lifts consists of a series of hydraulic presses contained in, and supported by, cast-iron columns sunk into the ground in two parallel rows, the space between being sufficient for the vessel to pass through.

From the cross-head of each ram the ends of a pair of girders are suspended; these girders pass across the dock, and form a platform on which the pontoon and vessel are lifted.

The pumping-power is a small steam-engine placed near the presses, the communication between it and the presses being through wrought-iron pipes. The engine does not pump direct into the hydraulic cylinders, but into an intermediate valve-chest, by which the raising power is regulated, and the uniform rise of the whole ship and pontoon secured.

The pontoons are large shallow vessels constructed of a wrought-iron framing and shell, and are divided into several water-tight compartments, in each of which is a valve. They are made of various sizes, corresponding with the weight of the vessels they are intended to carry.

The seven pontoons now in use vary from 160 to 320 feet in length, draw from 3 feet to 6½ feet when loaded, and carry vessels of from 500 to 3,000 tons.

The hydraulic rams will safely raise a dead weight of 6,000 tons, but can be adapted to lift any weight.

The peculiarities of this system are the raising the vessel to the level of the workshops and repairing-yards, and keeping it high and dry there in full light, exposed to the drying influences of the air; while from the vessel being carried above the pontoon, its bottom is more accessible.

The blocking or shoring the vessel under this system is most effectually and rapidly performed; the operation being simply the drawing in of blocks fitted to the side of the vessel, which blocks are carried direct on the wrought-iron transverse girder. The pontoon being highly elastic longitudinally, accommodates its shape to the keel of the ship, whatever be its form, thus securing a perfect bearing throughout.

The Thames Graving Docks Company, during the three years of their practical working, have most successfully docked upwards of 400 vessels, weighing 220,000 tons.

The model exhibited is unfortunately somewhat small, and will only serve to give an idea of the external arrangements; but the lift may be seen in daily use at the works of the company adjoining the Victoria Docks.

Messrs. W. Cory and Sons' float is designed for the purpose of unloading screw colliers or other vessels with great rapidity. The model exhibited represents a large float provided with six water-pressure cranes on Sir W. Armstrong's principle, each capable of working 60 tons per hour; apparatus for screening coals and depositing them into barges without breakage, is also provided. In the model two screw colliers are represented alongside; one has nearly completed discharging: the other is deep, having just arrived.

A model of a first-class graving-dock lined with masonry is exhibited by Messrs. Tod and MacGregor. It represents the dock built for the above-named firm by Messrs. Bell and Miller, on the Clyde, at Meadowside, Glasgow. The dock, which is 500 feet long, 80 feet wide, and has a depth of 20 feet of water at spring tides, is entirely built of squared freestone and granite masonry. The entry gates are of wrought-iron, weighing more than 60 tons. Very powerful pumping machinery is necessary, from the fact of the fall in the tide being only 8 feet at spring tides: a pumping-engine of 250 horse-power with two lifts of 52-inch pumps is provided, which empties the dock in two hours and a half without waiting for the ebb tide.

Messrs. G. Rennie and Son's combined floating-dock and patent slip-ways, although catalogued in Class X., are to be found among the naval models in Class XII., together with a section of the large floating-dock now being constructed by them for the Spanish government.

Messrs. Lawrence Brothers' canal sluice is illustrated by a model. It is so constructed that the pressure of the water is made to open or close it by means of a piston placed above the sluice-valve. The column of water in the upper reservoir is made to act either on the upper or lower face of this piston by a pair of small slide valves on the face of the sluice, which are worked by hand.

BREAKWATERS.

Exhibitors.—**G. Gibbs (2287), M. Scott (2337 and 2558).**

Mr. M. Scott's models show the plan of constructing breakwaters of timber and stone, by sinking in succession a series of frames put together on shore and floated to their places in order to serve as retaining cases for the stones which are afterwards thrown into them; the framing for forming the round head of a breakwater is formed of planking put together like basket-work, without the use of iron fastenings.

The timber employed is creosoted, and will protect the loose stones for many years without the use of expensive stone facings.

Another model of the same series represents a gridiron breakwater, having a series of cast-iron girders laid on the top of a wall of rubble and concrete, having a series of alternating spaces between them left for the waves to pass through without exercising any destructive effect on the structure. The model floating in a tank of water, which is placed near the last one represents a project for a moveable barrier for the defence of ports and harbours, made of brick cylinders, which are intended to be floated to their places and sunk, so as to bar the passage against an enemy. This model is placed in Class X., but is to be found in the catalogue of Class XI. The same principle is intended to be applied to the construction of foundations for forts in deep water. A circular cellular float of brickwork is to be brought to the spot, and then sunk by the admission of water into the cellular parts. Where the diameter of the work does not exceed 200 feet, it is proposed to sink the float in one piece, but for greater diameters, segments in brickwork to be sunk successively, are to be used.

DIVING APPARATUS.

Exhibitors.—**S. Barnett (2234), P. Effertz (2275), Fairfax, Bryson, and Co. (2278), Heinke Brothers (2296), A. Siebe (2338), Lawrence Brothers (2310).**

A model of a diving-bell, crane, and apparatus, by Messrs. Lawrence Brothers, shows the method of setting stones in foundations under water. A signal apparatus and safety-valve are attached to the bell, and are the same as those employed at the Admiralty Pier works, at Dover. The safety-valve prevents the bell from filling with water, in the event of the air-hose being broken.

Fairfax, Brison, and Co.'s model, represents a section of Maillefert's aërostatic tubular diving-bell, in which the working space is surrounded by a large air-chamber, which can be used as an air-reservoir, or for the purpose of lifting the bell, after the manner of a balloon.

Diving dresses and apparatus find three exhibitors; each one is distinguished by some improvement, although they are all similar in general appearance. Mr. Scott adds an indicating cylinder to the air-pump, which shows when any leakage or obstruction takes place, and provides for greater safety to the diver by having two air-tubes, one of which is used as a signal line. The diver's helmet has india-rubber flaps attached to it, to form a watertight joint in case the glass windows of the helmet should be broken.

Messrs. Heinke Brothers have also introduced improvements enabling the diver to remain under water when an accident occurs, such as the breaking of a glass, which would otherwise have allowed the water to penetrate into the dress. A lamp to be used in submarine explorations is also exhibited in this collection.

Mr. Augustus Siebe, the original inventor of the closed diving helmet, exhibits a figure in a complete diving-dress, with air-pumps and connecting-pipes attached. The helmet is provided with a segmental neck screw, by means of which the head can be removed by one-eighth of a turn. The cylinders of the air-pump are surrounded by a water casing, to prevent them from being unduly heated, by the rapid compression of the air when at work.

WINDOWS.

Exhibitors.—John Brown (2242), Burt and Potts (2248), G. H. Edwards (2274), W. H. Elkin (2276), J. Greenwood (2293), W. Holland (2299), S. Hood and Sons (2300), J. Askew (2368).

Mr. John Askew's patent sashes are an important improvement on the older forms; they are so contrived at the meeting bars or rails, that it is simply necessary to lift the brass knobs, placed at the sides, to sway the sashes completely round, and thus both sides of the glass can be rendered accessible for cleaning, from the interior of a room. In addition to removing a fertile source of accidents, the above plan is also useful for ventilating purposes, as by its use, large quantities of air can be introduced into a room without the fear of a direct draught.

Mr. W. Holland exhibits a sash window, in which the supporting chains are attached to the lower part of the sash-frame in such a manner that no portion of the chain is exposed whatever may be the position of the sashes. In the model the lower sash is arranged to be lifted by gearing, while the upper one is hung with a balance-weight, and can be moved by hand.

Various plans are shown for effectually closing doors and windows, among which are Brown's padded cloth strips, and Greenwood's india-rubber stops. Burt and Potts' air-tight fastenings for casements is formed by a moveable brass plate or packing attached to one of the window-frames, which is thrown into a groove on the opposite one when the window is closed, and locks them firmly together.

FOLDING SHUTTERS.

Exhibitors.—**Bunnett and Co. (2246), Clark and Co. (2254), J. Cresswell (2266).**

Messrs. Bunnett and Co., the original patentees of the folding iron shutters, exhibit their interlocking pattern, in which the edges of the iron strips or laths are turned, and they are put together by being slid endways into each other. The lifting or folding is effected by an endless drawing chain, working from the driving crank by means of a screw gearing.

Messrs. Clark and Co. exhibit various methods of making shutters self-folding, in order to dispense with lifting cords or chains. This is effected either by making the shutter of an elastic corrugated sheet of metal, or using a series of hinged laths, in which the elasticity is given by means of three parallel strips of thin steel.

Mr. Cresswell's shutter is noticeable on account of its extreme simplicity. It is formed of a series of flat laths hinged together, which are lifted by a single cord, like a Venetian window-blind. When not in use, the shutter folds into a low box, of the width of the laths employed, placed below the sash.

GAS RETORTS, GASOMETERS, &c.

Exhibitors.—**G. Bower (2240), J. V. Clarke (2257), Cookey and Son (2261), J. Cowen and Co. (2265), J. Edmundson and Co. (2273), Fishe Bros. and Co. (2281), G. Glover and Co. (2291), W. Ingham and Sons (2302), Laidlaw and Son (2309), Porter and Co. (2332), G. Simmons (2340), W. Stevenson and Sons (2344), C. Walker and Sons (2357), E. B. Beaumont (2371), J. J. Taylor (2404).**

The gas works exhibited are chiefly of the class intended for private houses and factories. Mr. G. Bower's apparatus consists of a conical retort, open at both ends, set vertically in a small furnace. The top is closed with a luted plug, and the bottom with a luted lid or door, which is raised by a forked bent lever when the retort is closed, and is kept in position by a swing catch and wedge. The hydraulic main, condenser, and purifier are combined into one small apparatus, and a gasometer is added, which, when it is intended for extreme portability, dispensing with planks or foundations, is made of vulcanized india-rubber, and is packed into a small metal tank for conveyance.

J. Edmundson and Co.'s portable gas apparatus resemble the above arrangement carried out on a smaller scale ; the furnace is arranged so as to make part of the heat available for cooking.

Messrs. G. Glover and Co., exhibit a copy of the standard gas holder, manufactured by them for the Exchequer. It is extremely interesting from the fact of its being the first in which extreme precision has been applied to the measure of gas; various novel arrangements are adopted, among which are the following:—The bell is made of an alloy of tin and antimony, a compound which is unaffected by water or the components of coal-gas ; a portion of the counterpoise weight is suspended from a cord passing over a spiral cam, in order to vary the mechanical moment of the weight at different positions of the gas holder. The scale of cubic inches is divided on the edge of the bell, and the finer divisions are read off by a telescope fixed to the frame of the cistern.

Messrs. Edward Cookey and Son's regulating gas valve is in use in a large number of English gas-works. It is formed of two cylinders, divided into segmental chambers, working upon each other horizontally, having their surfaces ground perfectly gas-tight. The chambers of the lower cylinder have branch pipes attached, communicating with the vessels, to and from which the gas is to be passed. The chambers of the upper cylinder correspond with those in the lower, but are so divided, as, when turned on the face of the lower one, to change the direction of the gas in its passage from one vessel to the other.

Simmons's gas and water connector is a machine designed for the purpose of preventing accidents in the process of connecting service pipes to gas mains, by preventing the escape of gas during the changing of the tools. The drill works through a stuffing-box, in a closed cylindrical case, which is fitted air-tight on to the main. When the drilling of the hole is completed, the drill is partly withdrawn from the stuffing-box; a handle on the left-hand side of the machine is then pushed in, which closes the hole, by means of an attached valve, and thus cuts off all communication between the interior of the main and the stuffing-box. The drill is then removed, the tap is inserted, and the valve is opened, so as to allow of the hole in the main being tapped; the tap is then withdrawn in the same manner as the drill was previously, and the connecting pipe being attached, the machine is removed.

The principal part of the collection of gas meters, burners, and other gas apparatus, will be found in Class XXXI.

WARMING AND VENTILATING.

Exhibitors.—**F. C. Cosser (2263), A. M. Perkins (2330), J. Askew (2368), Beagle and Co. (2370), F. Edwards and Son (2382), C. Kite (2389), J. McKinnell (2392), J. Moore (2393), W. Pierce (2395), J. H. Riddell (2397), S. E. Rosser (2399), T. Sowood (2402), J. Tenwick (2406).**

Mr. A. M. Perkins' patent hot-water apparatus, for warming and ventilating buildings is one that has been extensively used for this purpose. It consists of a continuous or endless tube of wrought iron, of five-eighths of an inch, internal diameter, a portion of which is formed into a coil, and placed in a furnace of wrought iron. The tube is filled with water, which is put into circulation by the application of heat to the coil in the furnace; and as the water becomes heated, it rises to the highest level of the circulating pipes, and thus forms a column of heated water lighter than the colder water, which descends to the lower part of the coil. When the requisite temperature has been obtained, the fire is governed by a self-acting arrangement depending upon the effect of heat on the iron pipe, which, by its expansion or contraction, is made to close or open the damper, placed in the furnace flue, through the intermediate agency of a train of multiplying levers.

Gurney's stove, exhibited by the London Warming and Ventilating Company, consists of a plain interior cylinder, with an external series of perpendicular radiating wings. The stove is placed in a pan of water, the evaporation of which is regulated so as to produce the amount of vapour required for the due saturation of the heated air; the air thus moistened is passed over the external surface of the stove rising between the wings, and thus the air of the apartment is prevented from being "burnt," or over dried, for no air is allowed to come in contact with the heated metal without receiving an intermixture of water vapour.

The same company exhibit an open fire-grate, arranged for supplying fresh air into rooms by an opening fed from an external source. A similar one is contributed by Mr. Pierce, in which the air is introduced through an opening placed behind the fire.

Mr. Pierce also exhibits a model of Huthnance's patent drying-room for large laundries: the heating arrangement consists of a small furnace, fitted with sliding fire-doors, having six horizontal tubular flues, like those of a locomotive running through the room at a short distance above the floor; a table of stone slabs placed above the flues serves for a hot drying plate: provision is made for the admission of large quantities of air through perforated panels placed in the doors of the room. The fire-doors of the furnace are placed in the adjoining ironing-room, and the top is arranged to form an ironing stove, which is enclosed by sliding doors, so as to prevent any escape of heated air from the drying to the ironing-room.

The consideration of stoves belongs more properly to Class XXXI., as the greater number of them will be found in that section.

FILTERS.

Exhibitors.—Slack and Brownlow (2341), E. B. Beaumont (2371), T. H. Danchell and Co. (2381), Lipscombe and Co. (2390), S. Cheavin (2377), Silicated Carbon Filter Co. (2400), T. Spencer (2403).

These articles form a small group placed at the entry of the court from the main Nave; they differ principally in the nature of the filtering medium employed, as for instance:—Mr. Thomas Spencer employs magnetic oxide of iron; the Silicated Carbon Filter Company's medium is a compressed mixture of animal charcoal, and finely divided silica; and Danchell and Co. use coarsely-powdered animal charcoal, placed in a stoneware case, into which the water is admitted from below through a series of fine holes, so arranged that the larger impurities, held in mechanical suspension, are prevented from entering the filter. The circulation of the water through the filter box is effected by means of a siphon tube.

BATHS AND LAVATORIES.

Exhibitors.—G. Smith and Co. (2401), J. Finch (2384).

Smith and Co. exhibit novel arrangements in baths and lavatories. The patent Egyptian bath, so called from its shape, which resembles an Egyptian mummy-case, has a horizontal shower-bath attached to it, which can also be used as a vapour bath, there being two wells or cisterns provided for holding heated irons for the purpose of raising steam. The universal lavatory combines into one piece of furniture the accommodation of the wash-hand, sponge, and foot-bath, the whole being contained in one framing; provision is also made for the immediate discharge of waste water through one of the tubular legs of the framing.

HOISTS AND LIFTS.

Exhibitors.—H. Allen (2228), M. Brown Westhead (2244) G. Dodman (2267), Lawrence Brothers (2310).

In this department, Messrs. Lawrence Brothers exhibit a model of a warehouse lift, fitted with a balance weight, so that a load can be lifted with a very small expenditure of extra power; also a model of warehouse crane with an expanding jib, by means of which a waggon can be unloaded or loaded, when standing in a street, across the intervening foot pavement.

Mr. H. Allen exhibits a model of another balance lift, arranged for lifting or lowering invalids from one floor to another; the same is intended to be applied for lifting goods in warehouses, when executed on a large scale.

Mr. Brown Westhead exhibits a method of applying the centrifugal regulator used in steam engines, for controlling the speed of a descending load. The divergence of the balls produced by any undue increase of speed, causes a pair of toothed catches to expand and bring the teeth into contact with the guides, on which the cage travels; and by the friction thus set up, the travelling velocity of the load is diminished; the catches are kept off the guides when not in use, by spiral springs acting against the regulator. In another modification of the same principle, by the same exhibitor, the catches are formed of the ordinary circular eccentrics, each bearing a small number of teeth on a part of the circumference.

Mr. G. Dodman exhibits a safety arrangement to prevent accidents by over-winding, in warehouses, collieries, &c. The cage is attached to the rope by a spring hook, which is opened by striking against a catch, in case the load should be lifted too high, and the cage, so detached from the ropes, is left hanging to the guides by a spring clip, similar to the one last noticed.

CORRUGATED IRON AND ZINC ROOFS, HOUSES, &c.

Exhibitors.—S. C. Hemming and Co. (2298), Morewood and Co. (2321), F. Morton (2322), J. Murray (2323), Tupper and Co. (2351), H. Vavasseur and Co. (2353), Vieille Montagne Zinc Co. (2355).

The principal constructors of works in galvanized corrugated iron, are largely represented in this class. The largest series of examples is contributed by Francis Morton, whose models show the method of applying iron roofs for covering large areas, such as docks for ship-building, railway-stations, &c. A rick yard 100 feet square can be completely covered in for 370*l*., or about 9*d*. per superficial foot. The patent tapered iron telegraph poles by the same makers are exhibited in half size models; they are formed of two tapering semi-elliptical pieces of galvanized iron, rivetted together into a column for the support of the insulators, for the conducting wires, and are intended for use in India, or other hot climates, where the use of wooden poles is inadmissible, on account of the rapid decay to which they are subject. Another modification shows the poles adapted both for telegraphic purposes, and to form the posts of a wire fencing, inclosing the railway.

Messrs. Henry Vavasseur and Co. contribute examples of the corrugated plates, used in the roofs of the railway-station, and in the construction of the Palace of Industry at Amsterdam.

Messrs. S. C. Hemming and Co. exhibit a large collection of drawings of churches and other buildings in which corrugated iron is employed; many of these possess considerable architectural merit, in spite of the ugly nature of the material.

The Vieille Montagne Zinc Company exhibit a large series of models, showing the application of sheet zinc for the purpose of roofing houses and larger buildings; one of them shows its advantage over tiles, in the power of employing a lower pitched roof, by which a greater height is obtainable in the attics of dwelling-houses.

Messrs. Morewood and Rogers, in addition to the examples of sheet metal exhibited in this Class, occupy a space in the Open Court of Class I., where a shed is covered with their continuous galvanized roofing sheets. This roofing combines strength, lightness, and durability. The special advantages which such a material possesses are obvious: any labourer on a farm, or in a factory, who can use a hammer, will be quite capable of applying this material. These exhibitors have recently introduced, in addition to their ordinary galvanized metal sheets, others which are covered with an uniform coating of lead. These are supposed to possess all the advantages of sheet lead; and they can be rendered at a considerably reduced cost.

CAST-IRON PIPES.

Exhibitors.—T. Edington and Sons (2272), W. Macfarlane and Co. (2313), R. Maclaren and Co. (2315), D. Y. Stewart and Co. (2345), Patent Bitumenized Water, Gas, and Drainage Pipe Co. (2327).

DRAIN AND SANITARY PIPES.

Exhibitors.—Beart's Patent Brick Co. (2237) E. Brooke (2241), H. Doulton and Co. (2268), E. B. Beaumont (2371), Bourne Valley Pottery Co. (2373), Burton and Waller (2375), J. Cliff and Co. (2378), J. Woodward (2412).

A small number of cast-iron and other water pipes are placed under the staircase at the angle of the S.E. Transept, among which are a 48-inch water-main, as used in the new Glasgow works, made by Thomas Edington and Sons; a series of pipes of various sizes, with turned sockets, by Stewart and Co.; and samples of tubes made of paper, coated with bituminous matter both inside and out, weighing only one-fourth of the weight of our tubes of an equal strength; exhibited by the Bituminous Pipe Company.

Messrs. W. Macfarlane and Co. exhibit a series of ornamental cast-iron pipes, for carrying off water from the roofs of houses; and other ornamental articles for roofs, such as gutters, crestings, and gable crosses. Most of these are very finely modelled and finished.

Messrs. Burton, Son, and Waller's collection of iron work, used in the drainage of towns, will be found close to the water-pipes; it includes safety grating, for the top of sewer shafts; balance valves, which are made to allow of water passing into the drain, but prevent the return of noxious gases by the same passage; valves for the mouths of sewers discharging into tidal waters, which close as soon as the pressure on the outer face exceeds that of the sewage stream on the inside; and a model of a charcoal deodorising apparatus, and pen-stocks as applied to the City of London sewers. Drain traps for house drainage, which prevent the escape of poisonous gases by means of a water joint, are shown in several varieties in the same neighbourhood.

MISCELLANEOUS OBJECTS.

The Central Cottage Improvement Society, which is established for the purpose of furnishing projects (plans and specifications) for suburban dwellings for artizans, and cottages for agricultural labourers, exhibit a model of a pair of cottages containing six rooms, which have been built for 215*l*. This is the highest class of plan furnished by the society; cottages with less accommodation, containing three rooms and a kitchen, can be erected for 162*l*.

Mr. William Munro exhibits a set of models of a similar character, for blocks of cottages, each making two dwelling-houses, which are estimated to cost from 120*l*. to 280*l*. each, according to the accommodation; the number of rooms in each house varying from two to seven, with the necessary out offices. Mr. Key exhibits similar models.

Mr. Sparkes Hall exhibits a model of a bench for shoemakers, which enables the workman to stand upright at his work, instead of adopting the cramped and unnatural position which has hitherto been considered necessary. A similar contrivance is exhibited by Mr. T. H. Burgess.

Mr. G. F. Downing illustrates the manufacture of oil-cloth by a model of the frames employed for straining the cloth, and a collection of tools employed in hanging and moving the painted cloths. Some of the frames in the model are constructed on an improved principle, whereby four pieces of cloth can be sketched upon one frame instead of two, as in the ordinary construction; by this means two fresh cloths can be operated upon during the time that those occupying the interior of the frame are drying.

The outer face of the screen, behind the model of Saltash Bridge, is occupied by Mr. George Parminter's cellular wine bin; the improvement consists in employing a series of small wooden cells, one for each bottle, instead of the old form of stone chambers, with loose laths and sawdust packing separating the bottles.

All the Stoneware is referred to Pottery, to avoid repetition.

SUB-CLASS A, devoted to *Civil Engineering and Building Contrivances*, and Sub-Class B., *Sanitary Improvements and Constructions*, have been considered together. It however appears necessary to treat Sub-Class C—*Objects shown for Architectural Beauty*—as an independent section.

The objects exhibited in this Sub-Class, which are not numerous, will be found, with a few exceptions, on the Eastern side of the East Transept under the Gallery.

As the exhibitors in nearly all cases selected the Class in which they desired to exhibit, it often unfortunately happens that the same description of articles appears in two or more Classes. Serpentine, and Granite, and Marbles, and enamelled Slate, are, for example, exhibited in Class I. and in Class X. It will therefore be necessary, in describing some of these, to refer to Class I., in illustration of the objects described in the Class which now engages our consideration.

In connection with the use of stones for ornamental and building purposes, I have been favoured with some remarks by C. H. Smith, Esq., one of the Commissioners for selecting the stone for the Houses of Parliament. These remarks are, of course, equally connected with the exhibition of the stones themselves in Class I., and their uses, as shown in Class X. In the descriptions of Class I. many of these stones have received especial notice; but the notes of so experienced a person as Mr. Smith, although they may repeat occasionally what has been already written, bear in the main so directly on the applications of the stones exhibited, as to form a useful and independent Essay—"On the Stones Exhibited, and their Uses."

In briefly describing a collection of materials, such as is now exhibited in the International Building, intended to be illustrative of the earthy minerals of this country, and of the application of various substances to the useful and ornamental purposes of man in a high state of civilization, it may be advisable, in the first instance, to say that although the collection may appear, to a casual observer, numerous and well selected—many of the specimens being remarkable for their beauty, dimensions, or physical qualities—it is nevertheless very far from complete. Notwithstanding many omissions, the display of raw materials belonging to Class I., and of manufactured articles, possesses extraordinary interest, and is instructive in an eminent degree. Some of the specimens may be considered to present the various qualities of the crude materials, unaltered by any process whatever. Others show similar substances manufactured with clay, common stone, marble, or granite; or a mixture to form cement and artificial stone, either with little or no labour, such as for road-making and pavements; or they may be worked into mouldings, polished, sculptured, or inlaid in the most elaborate patterns. These various kinds of manufacture are rarely, if ever, undertaken by the same artisan. Thus it will appear that a considerable diversity of subjects must be entered upon, to show the important relation they bear to each other, and to nearly all questions of architectural construction, decoration, and durability.

GRANITE.

Exhibitors.—Robertson and Hunter (2443), and in CLASS I.

It is now generally admitted by geologists, that the rocks which compose the crust of the earth may be arranged under two general divisions—the igneous and the aqueous; the former are considered to be destitute of organic remains; the latter are more or less disposed in beds or strata, and contain the fossil remains of plants and animals. Various causes have repeatedly disturbed, disintegrated, or decomposed the rocks, and so displaced their materials as at one time to sink and form the bed of an ocean, at another to rise thousands of feet, in the shape of cloud-capped mountain masses. The British Isles, in common with the rest of the world have undergone many submersions and elevations, before they last rose from the mighty deep, and remained to this time in a comparatively tranquil state.

In the order of creation, granite is decidedly among the oldest formations: as a general rule, it may be safe to say that no other rock is ever found beneath it; and it may be considered as the parent of most other rocks, especially of the numerous varieties of sandstone.

Granite is generally composed of coarse grains or crystals, of so hard and refractory a nature, as to render it only suitable for those bold massive structures which have scarcely any carving or other elaborate embellishment; Waterloo and London Bridges may be named as durable examples to illustrate this remark.

A large portion of the mass of all granite is made up of quartz or silicious grains, which is one of the hardest substances in nature—much harder than steel; therefore whatever ornament requires chiselling, can only be performed by a succession of moderate batterings, so as to force the grains to separate from each other, by concussion, not by incision of the crystals with a sharp-edged tool; for it is impossible to cut a hard substance with a comparatively soft instrument.

The ultimate form, whether mouldings, columns, or plain surfaces, is produced by friction with sand and water. The polishing is finished by weightily rubbing with moist "putty powder," (oxide of tin), in a thick wad of linen or woollen rags, which will readily yield to the form of the mouldings or curved surfaces: the whole is worked by the aid of large lathes, and other powerful machinery, and generally performed in the neighbourhood of the quarries.

The principal exhibitors of manufactured articles in granite are Robertson and Hunter, A. Macdonald, Messrs. William and John Freeman of Westminster, the Cheeswring Granite Company, and a few others. Most of the articles are sufficiently large to form a correct idea, either by minute inspection or viewed from a distance, of the effect of form, colour, or granulated structure; so as strikingly to illustrate the application of crude material to such useful or ornamental purposes, as are here exhibited, that is, large flat slabs, Tuscan columns and pilasters, chimneypieces, sepulchral monuments, drinking-fountains, vases, and numerous small works, besides many sample specimens. The whole are beautifully executed in all the different tints, from red to gray; presenting the highest finish of which any manufacture in this hard and intractable material is susceptible.

SLATE.

Exhibitors.—G. E. Magnus (2435), and several in CLASS I.

Slate is a very peculiar mineral substance, much more used now about buildings than formerly, therefore a short notice of its history and usefulness may be introduced amongst these subjects. It has been stated in some preliminary remarks that the decomposition of felspar in some varieties of granite produced enormous quantities of clay. The components of the earliest stratified rocks, the first series of which is the slate system, contain no elements which are not to be found in primitive granite. These deposits appear to have been originally formed by the united influence of water and atmosphere, not in a day, but by frequent or constant operations during ages, so as to produce a laminated formation of very considerable thickness. Over these, many other rocks were formed at the bottom of a deep sea, where they lay, probably, during many thousand years under the influence of excessive pressure from the superincumbent weight of solid and fluid materials. During that long interval, moderate subterranean heat appears to have exercised considerable impulsive power in hardening or changing the character of the primitive argillaceous deposit. The igneous, aqueous, and metamorphic rocks have not been allowed to rest in their original arrangement; movements from beneath have thrown them from their horizontal into inclined positions. From the depths of the ocean they have been hoisted to form not only dry land, but mountain masses of considerable elevation above the sea level. At this time the principal slate districts of North Wales are situated near the highest parts of our country, forming part of the Snowdonian line of mountains, certainly more than 2,000 feet above the water in St. George's Channel. The quarries which produce the largest, and perhaps the best, slates are in North Wales; but Cornwall, Lancashire, Cumberland, and Westmoreland are also celebrated for their slates. In Ireland, the island of Valentia and the county of Clare have slates of good quality.

Slate is a material of modern introduction for building purposes; it was first used for roofing in London after the Great Fire in 1666, on account of it being more durable than thatch, lighter than plain tiles, cheaper than lead, and not likely to be stolen. Good slates will resist all weather without alteration during almost any reasonable period. The transverse strength of Welsh slate is greater than any other mineral product of the stone kind. For these reasons it is used for a variety of purposes where strength, space, and cleanliness are important considerations: with such qualities no other material is so cheap.

Half a century ago, if a person of ordinary attainments had been asked for an explanation about slates, the answer would probably have been, that they were little thin things put on the tops of houses to keep out the wet; and that they might sometimes be noticed dangling on the back of a schoolboy to do his sums upon. They may now be seen numbered amongst the largest objects in the World's Exhibition. The Llangollen Slate Company have sent one measuring 20 feet by 10 feet, weighing 4½ tons. The Welsh Slate Company, whose quarries are at Festiniog, Merionethshire, have sent several slabs averaging 14 feet by 7 or 8 feet. All the slate from this neighbourhood possesses the remarkable quality of splitting with great facility, and with wonderful accuracy of surface, into thin laminæ or sheets. In the Eastern Annex there are many of these thinly-divided sheets, from 5 to 10 feet long, from 6 to 12 inches wide, and not more than the sixteenth of an inch in thickness; they are so elastic as to bend like a veneer of wood. There are also exhibited some small slates, of a greenish tint, from Carnarvonshire, and a few from Tintagel, near Camelford, Cornwall.

The utility of slate is no longer confined to roofing and school purposes as in days of yore. Not being subject to decay nor to produce dirt, like iron or wood, it is used in various ways; slabs three-quarters of an inch thick may be considered strong enough for shelves on which to deposit writings and other valuable property; for powder-magazines, larders, dairies, or wine-bins, it is an excellent material. A little thicker will do for balconies or foot paving. For billiard-tables slate is now superseding all other materials. The use of slate for cisterns, notwithstanding its frequent application to that purpose, is of questionable value on account of its being so unyielding to the expansion of water in frosty weather, and so difficult to make permanent water-tight joints.

ENAMELLED SLATE.

Exhibitors.—G. E. Magnus (2435), W. Stanley (2445); the Llangollen Slab and Slate Co. (204), J. Parkinson (262), (CLASSES I. and X.)

Some examples of this application of a comparatively cheap material are brought into immediate contrast with the best specimens of Nature's work. The objections which have been urged against what have been called "shams," in the language of a school which is not consistent with its own teachings, appear to me valueless. We produce, by artificial means, an imitation of a beautiful natural production. The expense of the latter confines it to the wealthy few—the cost of the former is so moderate that the mass of the people can enjoy the luxury.

Now, the imitations are so good, that even the practised eye, at a little distance, cannot distinguish them from the originals: pleasure is the result; everything pleasing influences the mind to good; therefore, if a Serpentine chimney-piece is too costly, the next best thing a man can do is to indulge his taste in the most perfect imitation.

Welsh slate of the most solid and compact kind is now extensively used as the groundwork for an immense variety of coloured ornamented articles known under the general term of "enamelled slate," invented and patented by Mr. Magnus, now practised by the Llangollen Slate Company, and several other parties. Slate, in addition to its being particularly hard and strong, will endure a heat more than twice that of boiling water, if gradually and carefully treated, probably equal to 500° or 600° of Fahr. Mr. Magnus states that he uses pigments somewhat analogous to those employed in porcelain works, with this difference, that his do not require so great a degree of heat to fuse or harden them.

SANDSTONE.

Exhibitors.—T. Earp (2427), H. Gomm (2432), T. Palmer (2438), and many in Class I.

The other component parts of granite are chiefly felspar and mica, neither of which is near so hard as the quartz. Felspar is a compound body, in which certain alkaline substances always form a predominant ingredient, rendering it extremely liable to decomposition, especially if it be exposed to the atmosphere in a damp or wet situation. While this process is going on, the lustre of the felspar is gradually diminished, its colour is altered, its hardness and cohesion destroyed, until at length the mass is completely changed into some kind of clay fit for pottery.

In some granite rocks felspar is more abundant than either quartz or mica; consequently if it be removed by the means just described, a rapid disintegration of the remaining portions must readily take place, leaving the silicious sand, mixed with certain quantities of mica, entirely separated from the clay and alkaline salts of the decomposed felspar. If sufficient time be allowed, the sand will ultimately become indurated into compact sandstone. This process of decomposition and partial induration must have gone on to an enormous extent, and continued through a vast period of ages, in order to have produced all the sandstone rocks which now constitute so large a portion of the earth's surface.

These rocks appear to have been formed either entirely under water or by frequent alternations of wet and dry. Sandstones are always more or less laminated, as if by the overflow and recession of a tide constantly leaving a sandy deposit, with minute plates of mica from the decomposed granite. Such plates being thin, compared with their size, are almost invariably found with their flat surfaces parallel to the lamination; thus distinctly indicating the bedway of a sandstone by their spangled or glittering appearance when viewed in a direction to reflect the light. The extreme tenuity and elasticity of the plates into which mica may be split, and the situation of the plates generally parallel to each other, will account for the readiness with which micaceous stones peel off in thin sheets.

The material so abundantly used in London, especially for foot-pavements, known by the general term "Yorkshire stone," is a good illustration of these remarks.

The hardest, most durable, and strongest sandstone, is generally of either a bluish-grey or comparatively of a pale-brown colour.

Mouldings, carvings, or other decorations on a small scale, will unavoidably occupy much time, if executed in Sandstone, on account of the nature of that substance, which is so destructive to edge tools. The only material used for sharpening edge tools is sandstone, either as a Hone or Turkey stone, used by joiners and cabinet-makers; grind-stone, scythe-stone, and many more, all of which are of a sharp sandy texture; therefore it is easy to conceive, that the same kind of stone which is found to sharpen tools most expeditiously, will also be the readiest to destroy their cutting edge, and thereby not only retard the progress of the workman, but occupy his time in frequently resharpening them.

Nearly all the North British sandstone used for building and for general architectural purposes, is obtained from the neighbourhood of Dundee, Edinburgh, Glasgow, and Newcastle-upon-Tyne. There is a good supply of fine block stone, or that which is very slightly laminated, to be had from the Duke of Devonshire's quarries in Derbyshire; and also from the Crown lands, Forest of Dean, in Gloucestershire. Most of the hard laminated sandstones, fit for landings, slabs, and foot pavements, are from quarries near Halifax and Leeds; those of a more free working kind, and not so decidedly laminated, are from the environs of Glasgow and Huddersfield. Although a sandstone quarry or district may usually be characterised as yielding either laminated or unlaminated stone, there are sometimes small patches of similar mineral substance, close by, perhaps even in the same quarry, of a different formation; for example, the celebrated Craigleith quarries are unmistakably laminated, and in beds averaging about 18 inches thick; yet occasionally, amidst these beds, lenticular masses of "Liver Rock" may be found, which are, to all appearance, free working stone; that is, free from stratification.

The rough specimens, and articles manufactured in sandstone, are too numerous to enter into a detailed account of each: the coarsest varieties are usually named "millstone grit;" they are frequently applied to grinding or crushing purposes; and many such articles are exhibited amongst the mineral products.

Mr. G. H. Hall, and Messrs. Trotter and Co., exhibit fine samples of free working sandstone, from the Forest of Dean, Gloucestershire; these large stones present scarcely any lamination; the colour varies in different quarries from a pale-reddish purple to a light-bluish gray, but each block is of one uniform tint throughout.

Messrs. Straton and Cargill, of Arbroath, Forfarshire, have sent some machine-faced hard sandstone.

Messrs. J. and R. Ibberson, also Abraham Graham and B. Graham, of Huddersfield, exhibit some good specimens of the softer varieties of sandstone, suitable for ashlar and general architectural works.

The corporation of Halifax, Messrs. Freeman of Westminster, Mr. Samuel Trickett, of the Isle of Dogs, London, and many other persons, have each sent comparatively small pieces of sandstone, presenting all the varieties to be procured from this description of rocks.

In the open area, adjoining the Eastern Annex, there is a fine example of a slightly laminated sandstone from Gazeby, worked into an obelisk upon a moulded pedestal, seemingly for a monument, by G. Vint and Brothers, of Idle, near Leeds. Close by there is another monument, designed in a mediæval style, and executed by J. Holmes, Bolton Wood Quarries, Bradford, in a most excellent quality of free working sandstone; it is almost impossible to detect the bedway of this stone without the most scrupulous and searching examination.

The largest Yorkshire slabs, or landings, in the whole collection, are those exhibited by Messrs. Nowell and Robson, from Summerley's quarry, Idle, near Leeds. The superficial area of these slabs is probably large enough for most building purposes, measuring nearly 14 feet by 7 feet. Larger slabs might be procured from many of the Yorkshire quarries; but as the inconvenience of transmission, either by road, railway, or water conveyance, would very materially add to the cost of them, such unwieldy articles are seldom required.

LIMESTONE.

Exhibitors named in the text, in CLASSES X. *and* I.

Amongst the mineral treasures of great importance to an industrious people, limestone is of considerable value, both for its use in agriculture and as being an indispensable ingredient in mortar for all kinds of substantial and durable buildings in every civilized country. Limestone is one of the most abundant substances in the creation; and from the prodigious districts containing the remains of crustaceous animals, fish shells, and corals, uniformly occurring in the contexture of many varieties of stone, it has been conjectured that marble, limestone, and all other indurated calcareous rocks, derive their origin and present appearance from the exuviæ of animals inhabiting the waters of ancient seas.

The chief sources of limestone used for ornamented architecture is usually obtained from the oolitic series of rocks which extend through England, from the extremity of Yorkshire to the coast of Dorsetshire, and across the Channel some distance into France; in many places affording prodigious quantities of free working stone for building—particularly that obtained from the environs of Bath and Bristol, from the Island of Portland, and from Caen in Normandy. There is also very good Oolitic building-stone at Ancaster in Lincolnshire, Ketton in Rutlandshire, Painswick in Gloucestershire, and at many other places along the Oolitic district. In some quarries the quantity of good stone may be insignificant, compared with the large amount of an indifferent kind which must be removed to get at that which is valuable, or of a marketable quality.

In all quarries of Oolitic limestone the most durable stone is obtained from the uppermost beds, but they are generally rather hard, coarse, and shelly. The lower beds are finer grained, softer, and thereby more expeditiously worked; but they are also more readily disintegrated when exposed to the weather.

It appears that nearly all the various articles in the present Exhibition that are manufactured in Oolitic limestone, are intended to be within buildings; certainly to be protected from weather, and the usual atmospheric influences. They consist of a Bath stone pulpit, elaborately carved to represent an oak tree, with roots, trunk, leaves, branches, squirrels, and birds perched thereon; the whole work is destitute of either a straight or circular line; exhibited by Cox and Son, Southampton Street, Strand.

Part of another pulpit (mediæval design), also in Bath stone, by Mr. Daniel Jones, of Bradford on Avon, Wilts. This is a good specimen to show the strength of the stone, which is perforated and cut through in a surprising manner, proving what the material will bear if carefully treated.

Mr. Farmer, of Walworth, London, exhibits a font executed in stone, similar to the before-named.

Mr. J. Wilson, of Grantham, Lincolnshire, has a font carved in Ancaster stone, which is a beautifully developed oolite, and seems to stand the weather exceedingly well, if an opinion may be formed from the condition of buildings in the neighbourhood of the quarries.

E. Tuffley, of Avening, near Stroud, Gloucestershire, has sent a beautiful little model of a Gothic staircase, executed in Painswick Oolite, which shows the fine-grained stone, and its fitness for work which requires to be minutely finished.

Caen Stone certainly belongs to the Oolitic series of rocks, although the ova can scarcely ever be observed in its structure. It is a foreign substance, very extensively imported, and much used by British architects and masons, on account of the low price of the material in the first instance, but more especially, for the facility and expedition with which it may be wrought into the most minute or elaborate ornaments; a skilful carver or mason being able to display a large amount of work in a very short time: hence there is a great temptation to use it externally for a variety of purposes for which it is decidedly unsuitable.

Mr. Thomas Earp, Kennington Road, Lambeth; Messrs. Edwardes Brothers and Burke, of Regent Street, and of Newman Street, London; Mr. H. Gomm, of Royal Street, Lambeth; Mr. James Williams, of Ipswich, and Messrs. Hardman and Co., of Birmingham and London, have used Caen stone as the ground-work or substantial part of their manufactures, that is, for receiving the coloured marbles with which they are inlaid and ornamented. Their works consist of fonts, fountains, pulpits, memorials, chimney-pieces, reredos, &c., &c.

In concluding our remarks respecting the oolites, it should be noticed, as somewhat curious, that Portland stone, which is one of the best building-stones ever used, and one that has been known, certainly, from the time of our eighth Henry, is scarcely represented in the present International Exhibition; though it has generally, if not almost exclusively, been applied to the best architectural edifices in London, during two or three centuries, giving general satisfaction to all who used it, until a recent period, when, for want of proper attention or supervision, large quantities of Portland stone, of a perishable and worthless quality, were used in grand public and private buildings; while at the same time there was a superabundance of most excellent and durable stone to be had from some of the neighbouring quarries.

Previously to 1623 this stone does not appear to have attracted any attention. From 1660 it has gradually grown into use. Inigo Jones restored a portion of Old St. Paul's, "casing great part of the outside, and adding a grand Corinthian portico to the west front, all of Portland stone."

St. Paul's Cathedral, and many of the public buildings of this country, have been built of stone from Portland, and it is still obtained from numerous quarries on the island for transmission to other places, and for the breakwater now in course of construction there.

The quarries from which the stone used for building St. Paul's Cathedral was obtained, were situated at the northern extremity of the island, but have been long abandoned in consequence of the stone being somewhat harder and more difficult to work than that met with in other parts of the island.

Sir C. Wren, in his "*Parentalia*," speaking of this stone, says, "All the most eminent masons of England were of opinion that stone of the largest scantlings were to be obtained there or nowhere. An inquiry was made after all the good stone that England afforded; and next to Portland, Roche Abbey stone, and some others in Yorkshire, seemed the best and most durable; but large stone for the Paul's works was not easily to be had even there."

The principal beds of stone quarried in the Isle of Portland are called, in descending order, *roach* or *roche*, *rubby bed*, and *whit* (*i. e.* white) or *best* bed. These beds vary much in thickness, but they may be stated to average five and six feet respectively; some reaching fifteen feet.

The following analysis, by Professor Daniell, gives the chemical composition of this stone:—

Silica - - - -	1·20
Carbonate of lime - -	95·16
Carbonate of magnesia -	1·20
Iron, alumina - - -	0·50
Water and loss - -	1·94
Bitumen - - -	trace
	100·00

The other principal localities where the Portland stone is quarried, are the Isle of Purbeck, in Dorsetshire, where it is called Purbeck-Portland; and the Vale of Wardour, where it affords a freestone of a very superior description.

About 40,000 tons of stone are exported annually from the Isle of Portland; a much larger quantity being employed in the government works.

There is a curious and novel example of ornamentation, executed with a machine, in Portland stone, by Messrs. Holroyd, Noble, and Collier, of Halifax: the pattern appears to be produced by some eccentric motion of a lathe; the idea is ingenious, because it may be varied to an innumerable extent.

Messrs. Westons exhibit only a small shaft, with plinth, base, and capital, in differents tones from their quarry. Messrs. W. and J. Freeman, and Mr. S. Trickett, have sent three or four insignificant, unwrought little specimens. But Messrs. Stewards, who are the largest Portland stone merchants, have not sent anything.

Amongst the collection of building stones, there is but one large specimen of Dolomite, or magnesian limestone, and that is an archway entrance to a church designed in an Early English style, and executed in stone from quarries at Steetley, near Worksop, by Henry Poole and Son, of Great Smith-street, Westminster: the constructive part is built with this stone, and enriched with columns of different-coloured marbles.

MARBLE.

Exhibitors.—**T. Hartley (2294), A. Bouceneau (2424), C. Clay (2426), Edwardes Bros. and Burke (2428), W. Field (2429), J. Forsyth (2430) G. Georgi (2431), G. Mitchell (2436), Poole and Son (2440), Serpentine Marble Co. (2444), W. Stanley (2445), Westminster Marble Co. (2447,) and in CLASS I.**

It would be difficult to determine where stone terminates and marble begins; scientifically, they may be considered nearly identical; pattern or colour is an immaterial distinction. If a fine-grained limestone be sufficiently hard and compact to take a good polish, it generally receives the more dignified name of "marble," although it may only possess such chemical qualities as are common to all calcareous earths. Carrara marbles consist of dove-coloured, veined, "Ravaccioni"—which is cloudy or small veined, and white statuary; they are all remarkably sound, free from cracks, shakes, or vents, and in the hands of experienced or careful workmen are not likely to break or come to pieces in any way. This may be one principal reason why the white Carrara marble is so generally used for large sculptural purposes, and in situations where it is protected from the weather it would be difficult to find a more beautiful or more fit material upon which the sculptor should exercise his art, than that of the Italian white statuary marble. But there are circumstances arising from its natural formation which ought to preclude it from being placed in situations where it may be constantly exposed to all weathers. The decay of statuary marble is facilitated by variations of temperature, which have a tendency to expand and contract the crystals, and thereby cause disintegration; of course this is most injurious where the variations have the widest range. If Carrara marble be fully open to atmospheric influences, the part most exposed to the heat of the sun will be destroyed before that which is in the shade. The mantel of a chimneypiece, immediately over the fire, is invariably in a crumbling condition long before the sides or those parts which are not so exposed to heat. Innumerable cases might be adduced to prove that Carrara marble, especially the whitest kind, is a material unsuited to bear the extremes of hot and cold, wet and dry, in our changeable climate; and that if it be exposed to the weather during thirty or forty years the crystals no longer adhere firmly to each other: the external appearance may remain unaltered, but the influence of weather continues to penetrate deeply into the mass, the cohesion of the particles is imperceptibly destroyed, and, after the lapse of about a century, it entirely falls into a kind of sparkling sand.

Good statuary marble may be considered to rank above all other mineral products in the adornment of internal architecture. Flaxman and Chantrey, Canova and Thorwaldsen, sought for no better material to execute their sublime conceptions of piety, heroism, grace, and beauty. A rough block of marble, worth only a few score pounds, after having been chiselled upon, a few months, in the studio of an eminent sculptor, may attain a world-wide reputation, and realize many thousands of pounds in competition amongst the royal or noble collectors of such works. The cleverest ideas of decoration, as applied to ornamental designs for furniture and general articles of luxury, are so closely allied to fine art, that they may be said to incorporate or blend into each other by imperceptible gradations. The chimneypiece executed by the late Mr. John Thomas, with bas-reliefs of Oberon and Titania, attended by Puck and one of the little elves, is unquestionably a work of fine art, displaying no ordinary amount of talent, either in design or execution; and yet it is, to all intents and purposes, a manufactured article of furniture—a mere frontispiece to a fireplace. Mr. Thomas's chimneypiece is decidedly sculptural. The next which claims attention is as thoroughly architectural, executed by G. Mitchell, of Brompton; Ionic insulated columns, with entablature, panels, spandrils, and mouldings richly carved; altogether, this is a good example of excellent marble and workmanship, applied to ornamental architecture. The other chimneypieces manufactured in statuary marble appear to be not only foreign material, but foreign workmanship also, therefore they do not come within this notice. There is one chimneypiece, executed by T. Hartley and Co., of Westminster, in Italian marble, which cannot be passed without some notice, on account of its colossal dimensions; it is composed of Bardilla and Ravaccioni, commonly but erroneously called Sicilian marble; it resembles one of those gigantic fireplaces in the baronial halls of olden times, when, if there were not a brazier for charcoal in the middle of the great hall, there would be an immense grate and chimney on one side, generating warm air enough for the supply of a little to each of the apartments around, as it was not customary in those days to have fires in any of the chambers or living rooms.

Probably no country of so limited an area as the British Isles is so rich in variegated marbles: Devonshire, Derbyshire, Westmoreland, and the western islands of Scotland; also Kilkenny and Galway in Ireland, are districts in which "mountain limestone," usually termed "marble," of great beauty and richness of colour, is to be found in abundance. Some of the British black marble is equal, if not superior, to any in the world for soundness, equality of texture, or uniform colour. Derbyshire has long been celebrated for its manufactures in this material; and many of the articles in the present Exhibition show that, however ingenious the artisans of that district may have been in past ages, their descendants in the marble line have not degenerated. The inlaid ornaments on a black marble ground appear to be bordering on perfection of workmanship; they consist of tables, vases, tazzi, obelisks, inkstand-trays, and numerous smaller articles beautifully made. Considerable doubts may arise on the subject of design, or the most fit and proper patterns for inlaid works. The best executed "mosaics," copied from clever pictures, with thousands of little bits of marble, glass, or earthenware, are but tame and feeble imitations of the artist's original painting or cartoon. The same may be said if larger pieces of marble are used, such as for inlaid work, somewhat after the Florentine method. To attempt the resemblance of natural objects, whether leaves, flowers, fruit, birds, or butterflies, if ever so well designed and executed with pieces of marble, is sure to be infinitely inferior to what the painter would do in a hundredth part of the time; and an article should not be estimated merely because it occupied a lifetime in its production. If an idea is to be taken from the vegetable kingdom, the general design might be rather formal or conventional, like an architectural ornament, not picturesque. Taking these considerations into account, it is exceedingly probable that something of the arabesque or geometric patterns, well arranged with reference to contrast of colours, light, dark, &c., might generally be the most favourable and pleasing. The exhibitors in this department are J. I. Turner,

S. Bright and Co., and T. Woodruff: these three firms are at Buxton, Derbyshire; their articles consist of large ewers, or vases, tables, &c., inlaid with malachite, spar, shell, lapis-lazula, and various coloured marbles. From Ashford, in the same county, we have black marble vases by Sydney Smith, and an inlaid table elaborately designed, representing fruit and flowers, by Samuel Birley. A. Tomlinson, of Bakewell, Derbyshire, has sent some architecturally-designed tables, which have a very good effect. J. Hall, of the town of Derby, exhibits some black marble obelisks, inkstand-trays, &c. R. Henson, of the Strand, London, has sent some marble ornaments, and Mr. Charles Clay, of Sidmouth Street, Gray's Inn Road, London, exhibits a table-top with 1,363 separate pieces of marble in its formation.

Many of the coloured marbles, whether British or foreign, are liable to defects of unsoundness, especially if the colours are not gradually blended one into the other. A large rock of variegated marble appears to have been formed during remote ages of the world by a congeries of small pieces of older rocks of different colours, sometimes firmly united into a compact solid block with a paste of natural cement; but it frequently occurs that the parts which were originally separate are not so strongly joined as to bear the long-continued battering of hammer and chisel during operations of the mason or carver; so that what was at the commencement of working a very insignificant crack or weak place, ultimately may come to pieces, in consequence of repeated vibratory concussions; and this may happen after the cost of two or three weeks' labour.

Mr. J. C. Stark, of Torquay, has sent some coloured slabs and two chimneypieces, all of Devonshire marble. John Lomas and Sons, of Bakewell, have sent ten slabs of Derbyshire marble; some of these display fossil encrinites and corals beautifully developed. There is also a large handsome slab of rather grey encrinital marble, from Ballinasloe, Galway.

In concluding these notes about marble, it may be stated that within a few years blocks of carbonate of lime of stalagmitic formation have been imported from California of an unusually rich, variegated brown colour. Their quality varies surprisingly even in different parts of the same block: in places it will be found full of holes, or so coarse as scarcely to be recognized as marble; within a few inches it may be close-grained, firm, and solid enough to receive the most beautiful polish. The really good and handsome portion can scarcely ever be obtained large enough for chimneypieces or table-tops without piecing or joining; but for small ornaments or veneered surfaces it is a valuable acquisition for the admirers of coloured marble. There are many small specimens and articles manufactured in this Californian marble distributed in various parts of the Exhibition; and a large octangular table-top, veneered upon slate and moulded on the edge, manufactured by Edwardes Brothers and Burke, is well deserving notice.

It is surprising that there should be but one solitary specimen of Purbeck marble in the Exhibition: this is about a foot cube, with one side polished, sent by Mr. James Voss, from his quarries at Woodyhide, near Corf Castle, Dorsetshire. During the middle ages this material was extensively used throughout England for the ornamental part of the interior of our sacred edifices. One instance may be named as an example for reference: a very large portion of the inside of Westminster Abbey is constructed with marble from some of the ancient quarries in the isle of Purbeck; the large piers or columns which support the groined roof are built wholly with this material, and most likely they were originally all polished.

SERPENTINE.

Exhibitors.—Serpentine Marble Co. (2444), Lizard Serpentine Co. Class I. (203).

That beautiful material usually known to mineralogists by the name of Serpentine is totally different in its chemical composition from any of those substances which are commonly denominated marble; the greater part of the former is composed of silica and magnesia, whereas marble is almost wholly carbonate of lime. In either case, the greater portion of the mass is considered, without reference to small quantities of colouring matter, such as iron, chromium, manganese, &c., which are more or less found in all coloured marbles or Serpentines. A genuine Serpentine always affords silica and magnesia in nearly equal quantities, making together from 70 to 75 per cent. of the entire mass, and a very small quantity of lime, rarely exceeding 2 or 3 per cent.; it also contains 10 or 12 per cent. of water of crystallization; but the proportional quantities are so various in different specimens that no general analysis can be attempted. The aspect of polished Serpentine is exceedingly various; the absence or presence of certain colouring matters which are frequently in its composition will do but little towards identification. Not unfrequently a large block will present several different compounds and colours. Diallage, Steatite, and Serpentine may be considered members of one family, so intimately connected that it seems difficult to separate them, passing gradually step by step, as they frequently do, into each other.

The Lizard Serpentines and Steatites are of many hues, from nearly white to black; clouded, veined, and spotted, with all the modifications of green and red; occasionally traversed in various directions with white narrow veins, generally of steatite.

The mode of working Serpentine, supposing it to be of a tolerably uniform close texture, does not generally differ materially from the usual practice of working hard, coloured, or black marbles; in fact, the sawing, sanding, chiselling, and polishing are accomplished by precisely the same means, and by the same masons or class of workmen.

Serpentine, like many of the coloured marbles, is liable to defects of unsoundness, such as cracks or vents, which render it likely to come to pieces while in the workmen's hands; of course these objections are more likely to occur if the dimensions are considerable. It has been stated by one of the exhibitors, in answer to the opinion that "Serpentine is not to be obtained of *any* size," that they have supplied shelves to two chimneypieces, each 9 feet long, without a defect. There is no rule without an exception; and if these long shelves are "without defects," they are certainly exceptions; for the almost universal rule with Serpentine is that of being extremely liable to unsoundness, unless of small dimensions.

The Serpentine Marble Company, of Penzance, Cornwall, and of Waterloo Place, London, have a great number of beautifully-executed articles, such as vases, fonts, pedestals, columns, small inlaid obelisks, balusters, table-tops, and a charming little timepiece case. The Lizard Serpentine Company, of Lizard, Cornwall, and of St. James's Street, London, exhibit an obelisk on a pedestal and steps, altogether 17 or 18 feet high; about a dozen other specimens are in the form of small cylinders; some of these appear to be of steatite: two chimneypieces, a large font, tombs and crosses, inlaid table-tops, and many small specimens.

William Pearse, jun., of Truro, Cornwall, has sent some Serpentine columns, tables inlaid with steatite, candlesticks, and a model of the mausoleum for the Duchess of Kent, at Frogmore, of which model the greater part is made of Serpentine. The whole of these articles are beautifully manufactured and polished.

ALABASTER.

***Exhibitors.*—T. Earp (2427), Poole and Son (2440), Hardman and Co. (Class XXXI.), &c.**

Gypsum, alabaster, and selenite are terms expressing very nearly the same substance; its principal ingredients are sulphuric acid, lime, and water of crystallization; it is softer than any of those minerals which present the appearance of marble. If it be crude, rough, and obtained only in small pieces, it is called gypsum, and is chiefly used for baking into plaster of Paris. The same material, if white, or ornamentally veined, and in good sized masses, is named alabaster, and used for many sculptural and ornamental purposes. When crystallized, clear, and transparent, it is called selenite; this latter is rarely found, except in small pieces. There is a variety obtained in thin beds entirely fibrous, usually named *satin-spar*, or *fibrous alabaster*, made into beads, brooches, and many other small ornaments. All the varieties of native sulphate of lime, or alabaster, possess nearly the same chemical characters.

Enormous quantities of gypsum are obtained in or about Paris; the celebrated hill of Montmartre is formed almost entirely of this material, used principally in the manufacture of plaster; hence the name "plaster of Paris." Derbyshire alabaster was never extensively used as a material for internal architectural decoration. During the middle ages, before the importation of Italian statuary marble, it was principally used for shrines, reredos, monumental sculpture, and other embellishments inside religious edifices. In the seventeenth and eighteenth centuries it was almost entirely out of use for articles of luxury or mere ornament; it was in those times occasionally baked to form a cement for plastering on reeds, to make floors in humble rooms where stone or tile would be too heavy, and oak—the only wood then used—too costly. Since the revival of mediæval architecture in the present century, alabaster is again occasionally introduced in sacred structures.

Notwithstanding alabaster is decidedly so soft a substance that it may be easily cut with a pocket-knife, or abraded with the nails, it is nevertheless an extremely durable material, if not openly exposed to the weather. In most of the large churches, in the south of England, especially in Westminster Abbey, there are instances of mural or sepulchral monuments, constructed with Purbeck marble, and ornamented with alabaster tracery, niches, canopies, and little figures, which are almost without exception, perfectly free from decay; angles sharp, surface smooth, colour scarcely altered; while the Purbeck, a harder material, upon which the alabaster is fixed, has scarcely any of the original surface left: although these two substances are close together, forming parts of the same monument, erected at the same time, equally exposed to the same atmospheric influences of damp and dry, summer and winter, from the fifteenth or sixteenth century, to the present time, yet one is apparently unaltered, while the other is as certainly perishing, disintegrating, and gradually mouldering away.

To give a true and correct statement of the cause of such remarkable differences in the duration of these two substances, would be attended with much difficulty and uncertainty; the two materials are undoubtedly very dissimilar, one extremely simple, the other complicated: alabaster is nearly pure sulphate of lime, well consolidated and uniform in texture: Purbeck is a mixture of two or three kinds of shells, imbedded in a mass of indurated clay, or mud, formed in the estuary of a large river. It is more than probable, that the simple substance would be but little affected by changes of temperature or moisture, because the alterations would be uniform throughout the whole mass; whereas the compound Purbeck might suffer in a variety of ways; the clay or earthy portion would absorb a great deal more damp from a humid atmosphere than the shelly part; therefore disintegration, assisted by frost and thaw, would be more materially facilitated in one case than in the other.

Before concluding the subject of alabaster or gypsum, it may not be altogether out of place to notice its value in disseminating a taste for sculptural art, amongst the middle and lower classes of society, who cannot afford to employ the sculptor, nor to purchase his works, either in marble or bronze. With carefully-made plaster casts, they may enjoy all the beauty of the original artistic sentiment, in any part of their dwellings which may not be sufficiently strong to bear the weight of marble, even if they could afford it. By the same means, the young student in art can obtain, for a few shillings, fac-similes of the most celebrated productions of the Phidian school, for his own humble studio: and further, without the aid of plaster of Paris, it would be difficult to determine how the most talented or the humblest sculptor could retain the permanent form of his previously made clay model, so as to point or measure from it while transferring his original idea into marble or bronze.

In the present Exhibition, Mr. Thomas Earp has introduced British veined alabaster for the upper part of a pulpit, decorated with open tracery and figures: also for the groundwork of a reredos, very elaborately wrought, and inlaid with numerous small pieces of spars and coloured marbles. Messrs.

Henry Poole and Son exhibit part of a reredos, executed in British alabaster, ornamented with a surface-painted pattern, and spots of coloured marbles and spars: the same parties have another specimen slab of alabaster, on which is an outline picture of the Lord's Supper; these works are offered as an illustration of an inexpensive wall surface decoration. Messrs. J. Hardman and Co. exhibit a life-size sitting statue of the Madonna and Child, in a richly decorated seat; this is altogether a large work, nearly all executed in veined alabaster; the face and one hand of the principal figure are of similar material, but whiter, and free from veins or defects of colour: no doubt these insertions have been judiciously adopted, to obviate the unsightly effect of veins or spots, interfering with the mildness expressed in the countenance of the Madonna.

Under the Eastern Dome will be found a series of studies from nature—casts by Mr. Brucciani, which, with the copies of celebrated statues, fully illustrate the application of plaster of Paris.

BRICKS.

Exhibitors.—Beart's Patent Brick Co. (2237), Fayle and Co. (2279), C. Stutter (2346), Bodmer Bros. (2372).

FIRE-BRICKS, RETORTS, &c.

Exhibitors.—T. M. Cartwright and Co (2249), E. Brooke (2241), J. Cliff and Son (2259), J. Cowen and Co. (2265), Gibbs and Canning (2288), J. Howie (2301), W. Ingham and Sons (2302), A. Lucas and Sons (2312), W. Stephenson and Sons (2344), E. B. Beaumont (2371).

The remarks which have been already made at page 26, on the various kinds of clays—and at page 32 on crucibles—render it unnecessary to occupy space, by repeating.

The manufacture of a brick is too well known to require any description. In character, bricks vary materially, according to the nature of the clay used.

In 1821, the number of bricks paying duty, were			899,178,510
„ 1840,	„	„	1,677,811,134
„ 1847,	„	„	2,193,829,491
„ 1849,	„	„	1,462,767,154

In this year the duty was repealed, and no attempt was made to ascertain the quantity made until 1858, when I instituted a very careful inquiry; the result of which was as follows:—

Bricks made - - - -	2,503,004,600
Value - - -	£2,911,980

TILES and TERRA COTTA, being exhibited in Class X., and in Class XXXV., will be dealt with when Pottery comes under consideration.

ARCHITECTURAL SCULPTURE AND EMBELLISHMENTS.

Exhibitors.—The Council of the Architectural Museum (2425), T. Earp (2427), and others.

In the eastern division of this Class will be found a varied series of architectural objects: some of the principal ones are briefly noticed in the following paragraphs.

Commencing at the extremity nearest to the steps of the Eastern Dome, we find the collection exhibited by Mr. Thomas Earp, which includes works executed after the most novel designs of Mr. G. E. Street, and other well-known architects.

The reredos for St. Philip and St. James, Oxford, built by Mr. Street, is an example of the new style of incised ornament, a kind of "niello" in stonework now largely employed. It consists of a central and two side panels in stone: the central one contains the sculptured subject of "The Agony in the Garden," executed in stone on a diapered background of a small triangular pattern in dull red, dark-blue, and green cement: the panels are divided by short red Devonshire marble, having sculptured stone caps of conventional early French foliage: the angle shafts are formed of green Irish serpentine. The arch enclosing the central panel is enriched with a flat pattern in cement mosaic and red Devonshire marble, relieved by projecting balls of polished fluor-spar from Derbyshire.

Another work designed by Mr. Street is the pulpit for the new church at Bournemouth, Hants, built by the same architect. This is of a circular form, and is principally constructed of Derbyshire alabaster. The base is formed of six short red sandstone columns, which carry the circular superstructure, the lower stage of which is a band of quatrefoiled panels in grey and green marble and fluor-spar mosaic, supporting an open arcade of alabaster arches on coloured marble shafts. The sermon desk is supported by a full length of an angel, sculptured in alabaster, bearing a scroll, on which is inscribed the legend, "How shall they teach, except they be sent?"

The dairy fountain, designed for the Earl of Sefton by Mr. J. Bentley, is of a very early Gothic type. It is formed of a cylindrical stone basin lined with lead, supported on a series of short red marble columns with square foliated capitals. The outside of the basin is divided into panels, in which are groups of figures in black incised work, representing the Four Seasons, alternating with geometrical mosaics in richly coloured marbles, among which are a peacock with the eyes in the tail feathers formed of polished purple fluor, malachite, and black marble, and a conventional representation of the Milky Way, also in marble mosaic. From the centre of the bowl rises a short marble shaft, with a square foliated capital in alabaster, bearing a sculptured group of a mother and child.

Another reredos, executed from the design of Mr. J. Bentley, is principally composed of richly variegated alabaster. It is divided into three panels of a vesica shape, the central one bearing a white marble cross enriched with fluor-spar ornaments and the evangelistic emblems on a red marble background. The side panels are embellished with groups in incised work, on a richly-coloured mosaic groundwork. The subjects of these groups are "The Women at the Sepulchre," and "The Annunciation." The panels are divided by polished marble columns, carrying figures of angels on their sculptured capitals.

A stone font, designed by Mr. S. S. Teulon, for Huntley Church, differs from all the foregoing examples by the adoption of a later style of ornament: it is supported on red marble shafts, having foliated caps cut after natural models.

A portion of a reredos by Mr. Williams is the only example of this class of work executed without coloured embellishment: it is in late decorated Gothic manner, and is composed of an arcade of five panels—the central one, which is the largest, has a low-relief sculpture of the Last Supper. Under a low ogee canopy the subjects carved in the side panels are, "The Nativity," "The Entry into Jerusalem," "The Agony in the Garden," and "The Crucifixion." The whole is surmounted by a line of ball-flower ornament, and an embattled parapet.

Messrs. H. Poole and Son exhibit a large collection of ornamental works in stone and marble. The principal one is the unfinished doorway, in Steetly stone, now being executed for the mortuary chapel of the Digby family, at Sherborne, Dorsetshire, designed by Mr. W. Slater. This work is in early French Gothic style, having pointed arched head enclosing a square-headed doorway: the tympanum between the lintel of the door and the arched hood is intended to be filled with a sculptured group of "The Resurrection." The jambs of the door are formed of stiff conventional foliate mouldings, alternating with columns having shafts of red, green, and yellow Sienna marbles, and Staffordshire alabaster, four on each side. A photograph of the finished design is attached.

A reredos, by the same exhibitors, is an example of cheap surface decoration. It is formed of Staffordshire alabaster incised in geometrical patterns, which are stopped with variously-coloured cements.

A portion of the marble mosaic pavement for Chichester Cathedral, designed by Mr. Slater and executed by Messrs. Poole and Son, in the richest English and foreign marbles, is placed among the engineering models on the opposite side of the Transept.

Mr. James Forsyth exhibits the model of a marble font and carved oak cover, designed by Mr. S. W. Dawkes, which has been executed for Witley Church, and a series of the carved oak bench ends, designed by Mr. Slater, for Chichester Cathedral.

The groups for which prizes have been given to artist workmen by the Ecclesiological Society in the award of the

Architectural Museum are exhibited in this Class. They include examples in each of the following classes:—Coloured decoration of sculptured panels, capitals in stone, carved in foliated pattern, foliage arranged in panels carved in wood, and figures sculptured in stone also in enclosed geometrical patterns. This collection is extremely interesting, and the carved wood panels are especially worthy of attention.

Messrs. Cox and Co. exhibit a Bath stone pulpit, carved into the form of an oak tree in full foliage, with birds and squirrels hiding among the branches.

Messrs. Edwards Brothers exhibit a highly ornamented geometrical Gothic mural monument, with polished marble shafts, and figures of angels, and a chimneypiece in white statuary marble, ornamented with arabesque, in the style of *cinque-cento renaissance.*

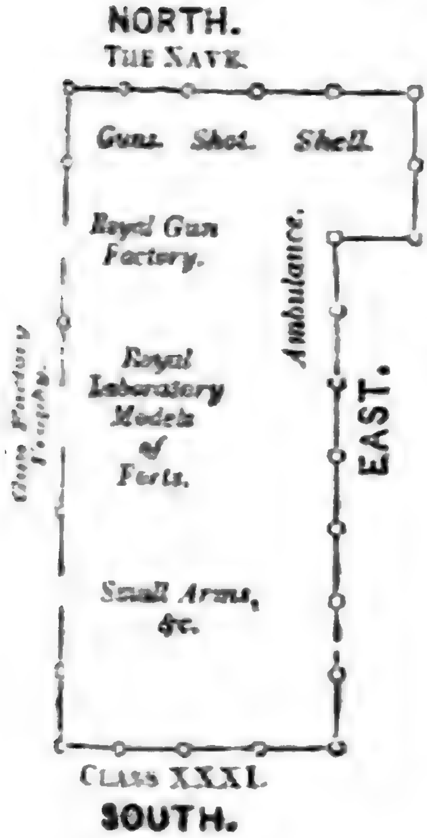
A chimneypiece in Caen stone, by Mr. H. Gomm, has a low arched head, and is ornamented with carved groups representing the fables of "The Cock and Jewel," and "The Fox and the Crow."

Messrs. Jackson and Sons exhibit a large series of specimens of *carton-pierre*, or moulded paper ornaments for rooms, the principal example being a chimneypiece surmounted by an oval mirror, flanked by female figures as caryatides in late French renaissance style.

Terra-cotta ornaments for architectural purposes are largely exhibited by Mr. M. H. Blanchard: a staircase, with encaustic tile ornament, is particularly noticeable. Mr. James Pelham exhibits fountain basins, and an ornamental columnar fern-stand, or "Ferndalabrum," in this Class, and a small terra-cotta fountain placed near the central entrance to the Horticultural Gardens.

Class XI.—Military Engineering, Armour, and Accoutrements, Ordnance and Small Arms.

Number of Exhibitors, 315.



Situation of Class.—*On the Southern side of the Nave; Class X., Civil Engineering, being on the Eastern, and Class XII., Naval Architecture, on the Western side; Class XXXI., Iron and Hardware, extending behind it.*

ORDNANCE.

Exhibitors.—Sir W. Armstrong (2509), Capt. Blakely (2514), Fawcett, Preston and Co. (2534), R. S. Garden (2538), A. Jeffery (2552), C. W. Lancaster (2557), J. Mackintosh (2564), Mersey Steel and Iron Co. (2567), Miller and Pearer (2568), F. Prince (2580), T. Restell (2584), W. Richards and Co. (2586), The Secretary of State for War (2596 to 2601), Whitworth Rifle and Ordnance Co. (2612), R. W. Woolcombe (2616).

The necessity of having guns of long range and comparative lightness of metal, combined with the power of throwing a heavy projectile, induced Sir William Armstrong to commence a series of experiments which resulted in the construction of his now celebrated gun.

There is a collective exhibition of some of his guns with their projectiles, and the parts of which they are composed, forming a trophy which indeed justly merits that name,—so frequently misapplied,—representing, as it does, the triumph of skilled labour directed by science.

The coil principle, which is a distinctive feature of all Sir William's guns, is very simple. It consists in twisting a bar of iron round an iron roller into a spiral, and then welding it into a continuous cylinder. It is however impossible to make entire guns of the necessary thickness in this manner, and Sir William therefore surrounds the inner tube by another, and so on until the requisite strength is obtained. By these means he has attained his original design of maximum strength with almost minimum weight.

The cast-iron 68-pounder service gun weighs 95 cwt. whereas the 110-pounder Armstrong gun only weighs 56 cwt. The range obtained with these guns is also much greater, than that obtained with smooth bore guns.

The Armstrong gun consists of three distinct pieces—the breech screw, the vent-piece, and the barrel. The vent-piece is entirely detached from the gun; it lifts in and out of the breech, and contains the vent.

The breech-screw is worked by a handle and serves to wedge the vent-piece against the side of the chamber, thereby preventing its being blown out by the explosion of the powder.

The manner of working this gun is very simple.

The screw receives two turns to the left, the vent-piece is removed, and the projectile and cartridge inserted through the end of the breech, the vent-piece is replaced, screwed home, a tube inserted in the vent, and the gun is ready for firing.

Land-service guns are fired by a friction tube; the sea-service, with a hammer and detonating tube.

A different description of the breech-loading principle is shown in the "wedge gun." This gun, instead of a vent-piece, has two wedges placed vertically in the breech, which draw out in opposite directions, and are so bored as to leave the bore of the gun entirely free when drawn out. When the cartridge is inserted the wedges are drawn back, and the gun fired. Immense rapidity of firing was obtained with a gun of this description, while it has not the objection of a screw, at all times liable to get damaged. A copper plate which covers the vent when the wedges are drawn out, prevents the gun from being fired until they are quite home.

The altered system of constructing guns required an entirely new description of projectile, sections of which, also the invention of Sir William, are shown. There are three descriptions of these projectiles: the common shell, the solid shot, and the segment shell. The common shell is a cast-iron cylinder with a conical head and flat bottom, an opening being bored in the apex of the cone for the insertion of the bursting charge. The shot is like the common shell, only solid and with a rounded head. The segment shell, which is intended to take the place of grape and canister shot, is constructed in the following manner:—The outside shell, a cast-iron cylinder, is filled with pieces of iron forming segments of a circle (varying in size according to the nature of the shell), a space being left in the centre for the bursting charge. These segments are then fixed in their places by a thin coating of lead, and the bottom added. The shell is then coated outside with lead, circular grooves having first been cut round it to prevent the lead from slipping off. The latter is called the undercutting.

The destructive effect of this shell is exhibited in a model showing a shell bursting in a close chamber: it must, from its construction, burst into at least as many pieces as it has segments, without the outer covering and lead coating. The 110-pounder shell contains about one hundred and twelve of these segments.

The fuzes, by which the bursting charge of these shells is ignited, are objects of great interest; they are also the invention of Sir William.

There are several descriptions of these; but the principle which has guided the construction of all is the "vis inertia" of one body resting upon another which is suddenly propelled forward.

The concussion fuze consists of an iron cylinder, in a chamber, at one end of which is some percussion powder. A needle, which serves to ignite the latter, is fixed to a copper bolt, which can slide in the cylinder when not retained by some copper wires that keep it in its place. The fuze is placed in the shell with the needle pointing towards the muzzle of the gun. When the gun is fired, the force of the explosion breaks the copper wires, the pin is freed, and upon the shell striking an object it is thrown forward by its own acquired velocity and ignites the percussion powder. From their construction these fuzes can be thrown about or dropped from a great height without danger, but after being fired from a gun, the mere fact of the shell stopping in its flight will cause it to explode.

The time fuze also contains a needle which, however, points in the opposite direction, and ignites the percussion powder the instant the gun is fired. The percussion powder, instead of being in direct communication with the bursting charge, ignites a piece of quick match, which in its turn sets fire to the composition that ignites the bursting charge. By turning a metal plate, this fuze can be so set as to explode after a required number of seconds.

These two fuzes are often used together as shown in the sections of shells here exhibited.

The Secretary of State for War exhibits a 20-pounder Armstrong naval gun, on top and under carriage, for boat service; a 40-pounder Armstrong sea-service gun on naval slide; a 12-pounder Armstrong field-service gun on carriage, with limber and ammunition waggon completely fitted with side arms, &c.

A list of the parts that belong to an Armstrong field gun may be of interest.

On the carriage are—one sponge bucket, two lubricating cans, four spare sponge coatings, one hammer, two handspikes, two camp kettles, one lanyard, one pair of pincers, three shots, two sponges, one wrench.

On the limber are—one felling axe, one pickaxe, one billhook, four fuze boxes, one grease box (tin), one tube box, two leather buckets, two canvas cartouches, two leather cartouches, one portfire clipper, eight fuzes, two holdalls, one spring lock key, one knife, one leather tube pocket, thirty shots, one shovel, one spade, one swingletree, eight friction tubes, five portfires.

The weight of the gun when packed is 37 cwt. 3 qrs., and it carries thirty-three rounds of ammunition.

The carriages of all these guns are fitted with a very ingenious contrivance for traversing the gun, without, as heretofore, having to move the trail.

A 10-inch mortar on travelling carriage is exhibited.

Formerly mortars could only be used in fortifications, in fieldworks, or on board ship; the one here shown can be drawn to any part of the field of battle, the block lowered from the wheels, and, having been fired, remounted and drawn away. Models of British artillery in use at different periods are connected with these.

A 110-pounder rifled Armstrong gun on platform and carriage, in the Nave (2597), is sent by the Minister for War also.

Models of Armstrong 12-pounder field gun, and limber, ammunition waggon, forge cart, and 12-pounder rocket carriage.

These models are deserving of notice, from the beauty and accuracy with which they are finished; they can all be taken to pieces, the interior fittings being exact copies of those in use.

The model of balistic and gun pendulum, used for proving the strength of powder, is interesting. The recoil of the gun, when fired, indicates the strength of the powder on a scale.

In connection with these are also exhibited:—A 12-pounder ammunition waggon with all its fittings, &c., such as are used in the army.

A packsaddle and portable forge, showing the manner of packing a forge so as to be transported on horseback where waggons cannot pass.

An ambulance waggon and barrow, the latter with a canvas stretcher to convey the wounded.

A wheel of a sling-waggon. These waggons are used for moving guns and heavy weights from one place to another. The gun instead of being lifted on the waggon is slung by ropes from the axle between the wheels.

A cast-iron, oval-bore, muzzle-loading, 100-pounder gun, 95 cwt, and projectiles, are exhibited by W. C. Lancaster. The shells fired from this gun are of one piece of wrought-iron, and weigh 82 lbs., with a bursting charge of 10 lbs.; the charge for the gun is 12lbs.

At a range of 4800 yds., a shot from this gun passed through a target representing the side of a corvette.

An 18-pounder, oval-bore, muzzle-loading field-gun, on carriage, is also exhibited by Mr. Lancaster.

P. M. Parsons exhibits a small, breech-loading rifled-gun, the construction of the breech-loading mechanism of which is simple. In the breech is a cone, bored through so as to form a continuation of the bore of the gun. This cone is connected with an iron handle, by means of which it is so placed as to allow of the cartridge being placed in the gun. The handle is then turned, and the bore of the cone placed at right angles with that of the gun, thereby completely closing the breech. To prevent the escape of gas, the cone moves in a coating of soft copper, against which it is forced when the gun is fired. The gun itself is rolled on Mr. Clay's principle by the Mersey Steel and Iron Co.

Messrs. Fawcett, Preston, and Co.'s muzzle-loading rifled gun is designed for mountain service; it fires a shell of 7 lbs., or solid shot of 9 lbs., and is said to range 1800 yds. at 5 degrees of elevation.

Whitworth's wrought-iron guns and projectiles will be examined with attention.

32-pounder	muzzle-loader	..	32 cwt.
6 ,,	,,	..	6 ,,
1 ,,	,,	..	97 lbs.
6 ,,	breech-loader	..	6 cwt.

Whitworth's guns differ in several main points from Sir W. Armstrong's.

1st. The bore of the barrel is hexagonal (the shot being of the same shape), instead of being round, with a number of grooves, as in the Armstrong gun.

2nd. The guns are not made on the coil principle, but forged in one piece.

3rd. The breech opens sideways, on a hinge, after the breech screw is opened.

An objection to this gun has been urged, which is the friction of iron upon iron caused by the projectiles not being lead-coated; and the breech screw being cleared of the breech, when the gun is loaded, making it liable to get out of order, on account of the screw having to be refitted into the thread each time, whereby the end is liable to be chipped if the gun is used hastily. Its powers are however remarkable.

At 30 degrees of elevation a range of 10,000 yds. was obtained with the gun here exhibited.

The charge of powder is about one quarter of the weight of projectile. The cartridges, instead of flannel, are contained in a tin tube, which has a hole at one end corresponding with the vent, to allow of the fire from the fuze passing through. The object of this is to prevent the escape of gas.

Captain Blakely is an exhibitor of a 200-pounder muzzle-loading gun (2514).

The peculiarity of the Blakely gun lies in the manner of its construction. It is formed of concentric tubes, each compressing that inside of it to a definite degree, ascertained by calculation and experiments. The object of this method of construction is to distribute the strain, produced by the burning of the gunpowder, more equally throughout the whole thickness of metal than it would be in guns either forged or cast in one mass, which always crack first inside, that portion being much more strained than the outside.

The rifling adapted by Captain Blakely for throwing iron shells is that invented by Commander Scott, R.N.; for throwing shot covered, or partly covered, with lead, as invented by Capt. Norton in 1823. Capt. Blakely uses the same form of rifling as is in the arms of the Chasseurs de Vincennes.

The Mersey Steel and Iron Co, Liverpool, exhibit the "Prince Alfred" gun (2567).

This gun is designed to illustrate another system of making guns of large calibre: its bore is 10 in.; it is loaded at the muzzle, and propels a projectile of from 500 to 600 lbs.; its weight is 10 tons, 15 cwt. 2 qrs. 14lbs.

In forging large masses of iron, such as the gun in question, it was found that the strength and soundness of the gun were impaired by the metal cooling unequally. This would be especially the case at the breech, thereby causing it to contract *from the centre*, which would naturally remain heated after the outside had cooled. This caused cracks and flaws in the interior of the gun, to obviate which the Mersey Steel and Iron Co. adopted the plan of forging the gun hollow, and screwing the breech on. This process allows the metal to cool equally inside and out. Before this gun was rifled it was capable of throwing a round shot of 136 lbs. weight.

This company, in 1856, constructed the 13-inch "Horsfall Monster Gun." A spherical shot of 282 lbs., projected from which, with a charge of 25 lbs. of powder, broke a 4½ inch wrought-iron plate. It may perhaps be interesting to know that this was the first armour plate ever broken.

Another plate 4½ in. thick, and backed by 18 in. of solid teak, was entirely destroyed by shot propelled from the "Prince Alfred" gun, by charges of 20 lbs. and 30 lbs. of powder respectively, the timber posts which supported the target being scattered over the beach on which the experiment was made.

The 18-pounder breech-loading gun, exhibited by this company, is again of different construction.

The barrel of the gun instead of being forged, is rolled and tapered by a double action of the rollers, and the breech and trunnion shrunk on. At the breech end, the gun is formed with a projection, or extra depth, on its lower side, to allow for the boring out of a circular screw-threaded bore or recess of much larger diameter than the bore of the gun, and with its centre considerably below the centre of the bore. Into this recess is screwed a cylindrical screw-threaded block or breech-piece, which closes the bore of the piece when screwed home. This has formed through it a cylindrical passage, so placed that when the breech-piece is turned back through a portion of a revolution, this passage comes exactly opposite to the bore of the piece, and allows of the charge being passed through into the barrel.

A pin is inserted at the upper right-hand portion of the end of the gun; this forms a stop for the handle to come against, and may be removed on loosening a thumbscrew that nips it, when it is desired to take the breech-piece entirely out of place for cleaning the parts.

This mode of making guns is patented by Mr. R. Clay of the Mersey Steel and Iron Company. The qualities which he has attained are—reduced cost, as compared with other guns; rapidity of fire, nineteen rounds having been fired in one minute from the gun here exhibited; non-liability of the screw to foul, it being completely covered; and strength of gun.

As an example of the latter quality, we may quote an experiment that was made with a 2-pounder gun of this construction. An iron cylinder, 5 feet 7 inches in length, weighing 88 lbs. and projecting 18 inches out of the muzzle, was fired from this gun.

After this it was loaded with eighteen shots and a 6-foot cylinder, which projected 5 feet out of the muzzle, and the projecting end of the cylinder placed against the solid rock. By these means *the gun was fired from the shot*, instead of the shot from the gun. This experiment was twice repeated without bursting the gun. The first charge was 1 lb. and the second 2 lbs. of powder.

These experiments were equal to firing a shot of 465 lbs., which is the weight of the gun.

The projectiles fired from these guns are coated with lead, like the Armstrong projectiles.

A cannon, and projectiles for projection, with cylindrical rotation, are exhibited by R. W. Woolcombe. Excepting in the form of its transverse section, the bore of this gun is in other respects like that of an ordinary smooth bore gun. The object is to secure the cycloidal rotation of a disc about its short diameter, and thus secure flat trajection.

Mr. Woolcombe also exhibits a target and pieces of wood to illustrate the effect produced by projectiles from this gun.

PROJECTILES NOT EXHIBITED IN CONNEXION WITH ORDNANCE EXHIBITORS.

Exhibitors.—**A. Jeffery (2552), Bashley Britten (2519), W. Hale (2545), Secretary of State for War (2602).**

Mr. A. Jeffery exhibits projectiles and their sections, to illustrate a series of experiments conducted by himself through several years to prove the efficiency of his principle for rifling ordnance. A detailed account of the results of these experiments would occupy too much space.

Mr. Bashley Britten shows projectiles of his own invention, to illustrate their construction, and his principle for boring guns.

Mr. W. Hale has a 500-pounder comet shell, some smaller examples of the same description of projectile, an apparatus illustrating the mode of firing them, and a set of rockets.

These comet shells are designed to take the place of rockets, which are at all times uncertain in their flight, owing to the stick being influenced by wind, to their coming in contact with any object, &c., &c. The apparatus from which Hale's projectiles are fired, consists of four rods of iron, varying in strength according to the nature of the projectile, so arranged as to form a slide, in which the shell or rocket is fixed. The shell itself is in shape an iron cylinder. The propelling power is produced in the same manner as with ordinary rockets. From the construction of the slide from which it is fired, this projectile can be used under water, so as to strike a ship below the water-line.

SHOT, SHELL, FUZES, ETC., MANUFACTURED IN THE ROYAL LABORATORIES, WOOLWICH.

Exhibitor.—**The Secretary of State for War (2602).**

It is only possible to give a short account of the most important of these, using for this purpose the numbers on the articles, which have no reference to the Catalogue.

1. Mallet's monster shell: diameter 36 inches, weighs about 1 ton 2 cwt. One of these shells was fired at the Woolwich range. After describing a circle of about three-

quarters of a mile in height, it penetrated the earth to a depth of 18 feet.

2, 3, and 4. Lieut.-Colonel Boxer's parachute light ball. It consists of an inner and outer shell. The latter, when the shell has attained sufficient height, falls off, and allows a parachute, which it contains, to expand, whereby the inner shell, which contains the composition, is suspended in the air, throwing light upon the surrounding country for a considerable distance. The object of this shell is to show an enemy's movements by night.

5. A case of various tubes used for proving and firing guns.
   a. The common quill tube.
   b. The Fynmore tube.
   c. The cross-headed detonating tube, fired with a hammer.
   d. The quill friction tube.
   f. The common brass tube.
   g. The galvanic tube.
   h. The magnetic tube.

The latter are used for proving guns, blasting, &c. These will be fully described under Class XIII.

The quill tubes are used for sea service, as the rebound of brass tubes, in a narrow space, would be accompanied with danger to the men working the guns.

6 to 13. Case shot. The tin case which is filled by small shot is broken by the force of the explosion, when the gun is fired, and the shot scattered about.

14 to 22. Various characters of round shot.

23. A "red-hot" shot. These shots are fired red-hot, and on account of the expansion of the iron when heated are made of a smaller gauge. They are painted red to prevent mistakes.

25 to 28. Congreve rockets from 6-pounders to 24-pounders, and sections showing interior construction.

30. Signal lights and signal rockets.

31. Moorsom's and Boxer's naval fuzes, and implements for preparing them for use.

32 to 38. Caffin's grape shot.

39 to 43. Armstrong shot of various descriptions.

44. Pettman's and pillar fuzes, and sections of ditto.

The principle of Pettman's fuzes is the same as Sir William Armstrong's. The fuze, being suddenly propelled, crushes some soft metal which keeps a small ball firmly in its place. Upon the shell striking any object, this ball is thrown against the side of the chamber in which it is confined, and being made with detonating powder, explodes it and ignites the charge. The pillar fuze has a metal pillar instead of a ball.

45 to 69. Armstrong shells—common, and segment, with sections of ditto—showing the construction of the shell and the manner of placing the fuzes.

48. Sections of an Armstrong 110-pounder segment-shell, showing the sections after they are fixed with lead, also the charge and fuze.

66. Sections of an Armstrong 110-pounder segment-shell, showing the segments before they have been fixed with lead, and before the shell is lead-coated.

70 to 78. Armstrong cartridges, from 6-pounders to 110-pounders.

79 to 83. Cartridges for cast-iron smooth bore guns. The natures and weights are written upon them, which facilitates a comparison between the charges required for rifled and smooth bore ordnance.

The service charge for a 110-pounder rifled Armstrong gun is 12 lbs., whereas that of the cast-iron 68-pounder service gun is 16 lbs.

70 and 71 show the manner of fastening Lieut.-Colonel Boxer's lubricator, the construction of which is shown in 76. It is a case of thin copper, containing a lubricating material, and is screwed to that end of the cartridge which touches the projectile. When the gun is fired, the case is crushed and its contents forced into the grooves of the gun.

84 to 89. Various descriptions of cartridge barrels.

89. Is a section of the same, showing the manner of packing the cartridges and percussion caps.

92 to 97. Various kinds of metal powder-cases. These

are used for stowing powder on board ship, being shaped in such a manner that they can be stowed in the ship's hold without danger of shifting.

98. A 13-inch smoke-ball, used for the purpose of disguising the movement of troops.

99 and 100. Projectile and section of the same, for Manby's life-saving apparatus. This projectile has a cow-hide thong, to which a line is fastened. In case of a vessel being stranded at some distance from the shore, the projectile is fired from a mortar, so that those on shore may secure the line falling across the rigging of the ship.

101 to 123. Lieut-Colonel Boxer's diaphragm Shrapnell shell, with sections and gauges. This shell, which is designed to be used against troops in the field, is filled with leaden bullets, which are steadied by coal-dust. A small chamber, or diaphragm, contains sufficient powder to break the shell, when the bullets continue their flight with the same velocity as that of the shell at the moment of bursting.

125 to 127. A 13-inch carcase, with section and gauge. Carcases are used for setting fire to ships or buildings. They are filled with a composition which, when ignited, bursts out at three holes made for this purpose, and cannot be extinguished.

128. A case of common wooden fuzes and implements for each nature of shell.

130 to 151. Various mortar shells, sections showing charge and fuzes, and their gauges.

153 and 154. A model of Martin's shell, one of the deadliest inventions of modern warfare. It is a shell of unequal thickness, being thinner at the sides than at the top and bottom, and lined with a coating of softer metal. This shell is filled with liquid iron, and upon striking an object is crushed by its own weight, the liquid iron being scattered about in all directions.

156 to 165. Machinery used in making the moulds of shells in the Royal Arsenal.

Small Arms.

There are a considerable number of exhibitors, numbering from 2466 to 2617 in the Catalogue. It is not possible within the limits of this work to notice the peculiarities of each.

The material for the barrels of the arms made at the Government works is brought to the factory in slabs half an inch thick, and 12 inches long, by 4 inches broad. These slabs of iron are carefully forged, to insure the crossing of the fibres of the iron. They are heated, and first bent into a tubular form; they are then heated again, and, while white hot, passed between iron rollers, which weld the joining down the middle, and at the same time lengthen the tube nearly three inches. This heating is several times repeated, and the process of rolling continued until the barrel assumes the form of a rod about 4 feet long, having a bore down the centre about a quarter of an inch in diameter.

The muzzles are then cut off; the "butts" made up, and the process of welding on the nipple lump is begun. This operation requires much care, and it is executed with great quickness and skill by the trained workmen. The barrels pass from the smithy to the boring department. The barrels are arranged horizontally, and the first sized borer is drawn upwards from the breech to the muzzle. The second boring is effected with rapidity, but the third slowly; and after the fourth boring the barrel is finished to within the $\frac{3}{1000}$ of an inch of its proper diameter. The outside is ground down to its service size, and the barrel is straightened; it is then tested by a proof charge of 1 oz. of powder and 1 ball. The next step is to fit the nipple-screw, nipple, and breech pin. The barrel is then bored for the fifth time, and it passes to the finishing shop. In rifling the Enfield, each groove is cut separately, the bit being drawn from the muzzle to the breech. The depth of the rifling is 0·5 at the muzzle, and 0·13 at the breech, and the width of each groove is $\frac{3}{16}$ of an inch. After rifling, the barrel is again proved, with half an ounce of powder and a single ball. It is then sighted, trimmed off, milled, levelled, browned, gauged, and at last finished so perfectly that the steel gauge of ·577 of an inch passes freely through, while that of ·580 will not enter the muzzle.

The prime cost of a finished Enfield rifle is stated to be about 2*l*. 5*s*., and from 1,500 to 1,800 rifles per week are at present made at the Enfield rifle factory.

BREECH-LOADING RIFLES.—Mont Storm's principle of constructing breech-loading fire-arms is perhaps one of the best at present invented.

The advantages may be enumerated as follows:—It has not the usual lever, which is liable to catch in the dress or accoutrements; it is confined to no particular ammunition; it is applicable to all descriptions of fire-arms; the connection between the barrel and the stock is not weakened, therefore it is adapted for the use of the bayonet; the opening and closing of the chamber is effected with perfect ease; it cannot be fired intentionally or accidentally until the chamber is perfectly closed. There are several exhibitors of breech-loaders, which can only be studied with the weapon before us.

Vallance's improved system of placing and igniting charges in fire-arms (2610) is ingenious.

The exhibitor's system consists in placing the charge of a gun in a conical chamber, having the base of the cone at the farthest end from the muzzle of the gun, and igniting it in front. By proportioning the diameter of the chamber and the angle of the cone to the length of the barrel, it is possible for the entire charge to be ignited, just before the shot leaves the muzzle of the gun. By this means the greatest velocity may be given to the shot, although it is very gradually started from a state of rest.

The rifles generally demand a more especial notice, being, as examples of workmanship, excellent; but any extension of the remarks made would lead to a treatise for which room could not be found in this small volume.

MILITARY ENGINEERING.

Exhibitors.—Col. Adair (2505), Bayliss and Son (2511), Lord Clinton, R.N. (2524), Secretary of State for War (2525), Capt. Donnelly, R.E. (2528), Capt. Du. Cane (2531), G. Fawcus (2535), Capt. Fowke, R.E. (2536), Lieut.-Col. Lane Fox (2537), Gisborne (2541), Hemming and Co. (2547), Col. Sir H. James (2551), Serjt.-Major Jones (2554), W. H. Lucas (2563), J. Lovell (2562), Mersey Steel and Iron Co. (2567), W. E. Newton (2573), M. Scott (2588), Secretary of State for War (2591 to 2595), Capt. Tyler, R.E. (2609), T. White (2611), Major A. Moffatt (2623), S. Minton (2622).

Half Model of a Wing Hospital, for use in tropical climates, is exhibited by Major A. Moffatt, H.M. Bengal Staff Corps, by whom it was constructed at Umballa, N.W. Provinces of India, in 1859.—This building is raised three feet from the ground, which is sloped off to a distance of 50 feet on all sides; it is to afford accommodation for 80 men, allowing 2000 cubic feet of space for each man.

The main roof covering consists of two layers of one-inch bricks, over which are placed eighteen inch tiles, three-fourths of an inch thick.

The verandah roofs consist of two layers of one and a half inch bricks, covered by three inches of concrete, with half-inch Chunam plaster. Thorough ventilation is secured by large flues, which are carried from the cross walls, and at the angles of the main rooms through the roof, and are covered with large slabs, which become heated by the tropical sun and tend to exhaust the air.

The main roof is so pitched as to present the smallest area to be acted upon by the sun's vertical rays at any period of the day.

It has been found that the barometer stands lower under this than any other description of roof.

Iron-band suspension bridge, gabions, &c.—This bridge is made of a number of galvanized iron bands, laid side by side, like a wickerwork mat, and fastened together by bolts and nuts. The ends of the bands are formed into loops, through which a horizontal pole is passed and fastened to stout balks. By placing three or more of these iron bands one above the other, the bridge is rendered strong enough for the passage of cavalry or artillery. The exhibitor also applies this principle to the construction of field bedsteads, ambulance litters, rafters for stabling, gabions, a trip to check the advance of infantry and cavalry, and gabions. Amongst the models, the more interesting are a model of projected casemated work as a continuation of Hurst Castle, to protect the passage of the Needles; and a model of Hilsea Lines.

MILITARY MODEL OF LONDON AND ADJACENT COUNTRY.

This model illustrates a projected line of defences round London—consisting of nine forts connected by redoubts and earthworks, enclosing an area of 22 miles by 14 miles. The sites proposed for the forts are; Telegraph Hill, Forest Hill, Tooting Common, the Ridgeway, Richmond Park, Mortlake, Ealing, Hanger Hill, and Whembley.

These forts and lines would mount 2,151 guns, at an estimated expense of 4,136,125*l.*

BATTERY FOR THE PROTECTION OF RIVER MOUTHS AND HARBOURS.

This battery resembles a low round tower, rising only a short distance above the water, with a conical roof.

This tower is inside another tower, resembling a gigantic circular tank (completely hidden below the water line), and in which it floats, merely kept in its proper position by rollers at the sides, and the axis upon which it revolves in the centre.

The friction which would be caused by so heavy a body revolving on machinery is reduced to a minimum through its floating in the outer tower.

From this tower a continual fire is supposed to be kept up at an enemy—the tower revolving as fast as the guns are fired.

Gisborne's Electrographic target and signal apparatus (2541). The peculiarity of this target consists, 1st, in the wrought-iron sectional plates being set on different planes, so that line shots only are recorded from the first plate on which the bullet strikes. 2ndly, by the use of synchronous instruments only one communicating wire is required for any number of sections or divisions, &c. 3rdly, each shot that strikes the target records its position upon a miniature paper target diagram at the firing-stand.

ACCOUTREMENTS AND CAMP EQUIPAGE.

Eight exhibitors make a very imperfect display of clothing and accoutrements; and the nine or ten exhibitors of camp equipage do not illustrate this section as it deserves.

Cotton, Edgington, Pilcher, Turner, Unite, and Major Rhodes are exhibitors of tents.

Major Rhodes appears to have introduced several improvements. The difference, as it regards weight and convenience, in those tents introduced, is very great. We regret our space will not admit of detail: this, however, is somewhat compensated, by the ample detail to be found in a book, "Tents and Tent Life," published by the inventor.

Ambulances and waggons of every description in use on the field are exhibited.

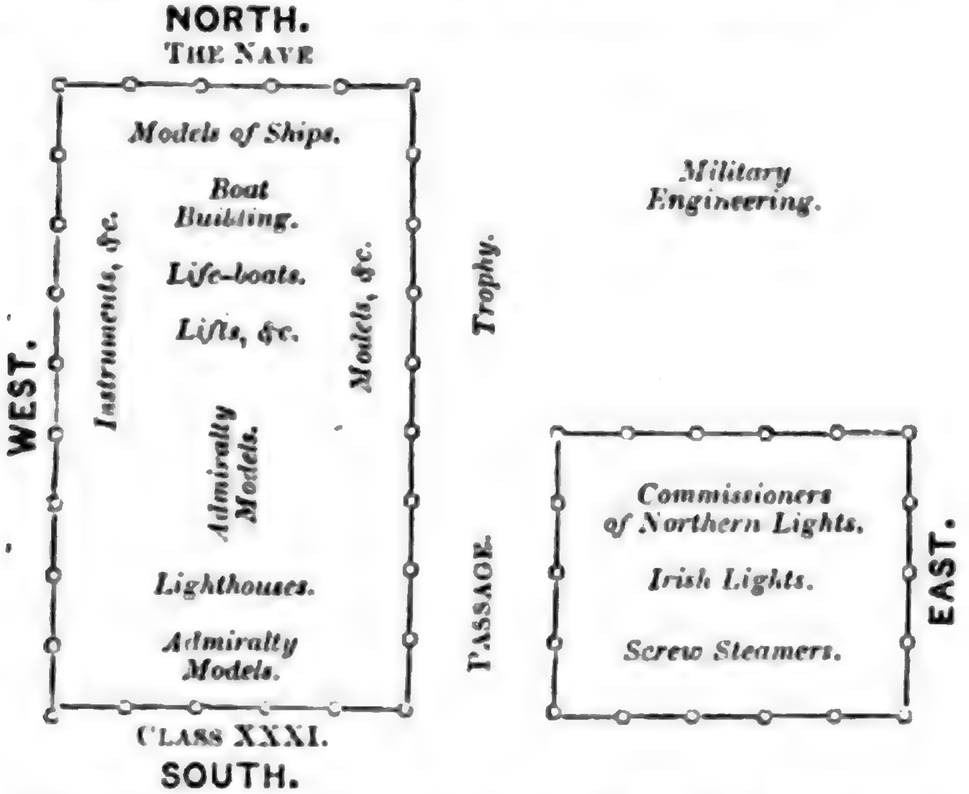
Colonel Sir Henry James is an exhibitor of the Ordnance Maps, and his process of photo-zincography, which will be fully described in the section devoted to photography.

Of the Ordnance Trigonometrical Survey, it may be stated that whether we look at the maps on the one-inch, the six-inches, or the larger scales, they must be regarded as a great national work of which we may be justly proud. In connection with those, the maps of the Geological Survey in Class I. should be examined.

CLASS XII.—NAVAL ARCHITECTURE. SHIP'S TACKLE.

Number of Exhibitors, 159.

SITUATION OF CLASS.—*Court South of the Nave immediately following Military Engineering; Class XXXIV., Glass, being on its Eastern side, and Class XXXI., Iron and Hardware, behind it.*



SHIP-BUILDING FOR VESSELS OF WAR.

Exhibitors.—The Lords of the Admiralty (2735 to 2742), Captain Cowper Coles (2741), C. J. Mare and Co. (2699), D. Dunlop (2670), I. Jecks (2692), Thames Iron Company (2725), Capt. Peacock (2796), R. Roberts and Co. (2715), J. W. Couchman (2663), G. Ellis (2673), R. Griffiths (2683), W. Hale (2684), J. Jones, jun. (2693), M. Pearse and Co. (2704), J. Richardson and Co. (2712), W. Sadler (2720), B. Sharpe (2722), E. Bell (2740A), T. Henderson (2741A), Capt. Jerningham (2742), Mrs. Kynaston (2742A), J. Nasmyth (2742B).

MODELS OF SHIP-BUILDING WITH REGARD TO MEN-OF-WAR.

This series of models illustrates the progress of ship-building (at least as regards ships of war) since the earliest times.

The first model illustrates the manner of launching ships, in use until 1795, when it was superseded by the second, which is still in use.

Next to these comes a model of "The Great Harry," ordered by Henry VII., but only launched in the reign of Henry VIII. She carried 50 guns, was of 1000 tons burthen, and cost £14,000 to build. "The Great Harry" is considered the first vessel of importance in the British navy. After her the next vessel of importance was "The Sovereign-of-the-Seas," 100 guns, launched in 1637 for Charles I. She was built at Woolwich dockyard by Phineas Pett. A representation of this vessel was for a long time used on the Admiralty seal, attached to captains' commissions, &c. "The Royal William," 100 guns, launched ten years after the restoration of Charles II. in 1670, was for a long time the guardship at Spithead, where she was the depôt for all the men brought in by the press-gangs. She was broken up about forty years ago.

"The Royal George," 100 guns, built in 1756, is also represented by a model. Her melancholy fate is well known. She went down at her moorings off Spithead, with Admiral Kempenfeldt and a crew of eight hundred men, in 1782.

After the "Queen," 116 guns, built 1838, comes the "Howe," 121 guns, the last "three-decker" built for the British navy. This model is a fine illustration of a class of ships that have become nearly useless from the success of recent experiments in constructing amour-plated vessels.

The "Euryalus," 51 guns, launched in 1853, was our first frigate fitted with the screw propeller.

With these are—a model of the "Gorgon," 6 guns, 1111 tons burthen. This vessel is interesting from a curious episode in her career. Having been sent to Buenos Ayres in 1834 she was dragged from her moorings in a violent gale of wind, and stranded "high and dry" on the beach, where she remained for several months. She was at length got off by the crew digging a "dock" in the sand, and refloating her.

The model of the "Terror" will be regarded with interest, from the fact of her having conveyed Sir John Franklin and his luckless crew on their last journey.

The details of the progress made in building these ships, are shown by some long sections of ships.

The first great improvement was made in 1811 when Sir Robert Seppings commenced constructing vessels with diagonal frameworks and decks. This plan added greatly to their strength.

In 1832 Sir W. Symonds further improved the construction of our ships by making them broader, and giving increased height between the decks, a great boon to the men working the guns.

A model of H.M. yacht "Victoria and Albert," with her tenders, is well worthy of notice. It was entirely constructed by Mr. G. Piercy, modeller to the Admiralty, and shows great neatness in workmanship.

On the wall above these is a series of half-block models of vessels from 1765 up to a late date.

The first of these is the "Victory," 121 guns, Nelson's flag-ship at the battle of Trafalgar. Many of the others are repetitions of those above mentioned until we come to the new class of iron-clad vessels.

The first of these is the floating-battery "Erebus," 16 guns, and 1954 tons burthen, launched in 1856.

After her comes the "Warrior," 40 guns, 6109 tons burthen, the first of the monster frigates..

A beautiful model of the "Warrior," with a most instructive section, is placed in the Nave.

This is a model of our first iron-cased frigate of the class to which belong the "Northumberland," "Minotaur," "Defence." The armament and construction of the "Warrior" are very similar to those of the "Northumberland," described below, excepting that she has no projecting stern, and carries a few guns less.

The "Warrior" is succeeded by the "Defence," 16 guns, 3720 tons. The "Hector" 32 guns, 4063 tons. And the "Minotaur," 50 guns, 6621 tons.

Opposite these is a full block model of the "Northumberland," the sister ship of the "Minotaur."

This model is exhibited by Messrs. C. J. Mare and Co., by whom the vessel is being built.

An account of the principal dimensions of this vessel will also indicate the size of the others of this class. She is 400 feet long, 59 feet 3 inches broad, 21 feet deep in the hold, and draws 25 feet of water fore and 26 feet aft. She has a running-down stem, and is coated with 5½-inch armour plates, which are backed by 9 inches of solid teak. The total weight of her amour-plates is 5320 tons. Her tonnage is 6620 tons.

The wrought-iron crank-shaft for the "Northumberland" is exhibited in Class I. by the Mersey Steel and Iron Company, it weighs 25 tons. On her deck she carries ten Armstrong guns; eight 40-pounders at the sides, and a 110-pounder at the bow and stern.

Beside her is a model of the "Queen," 116 guns, already mentioned. The "Queen" was built in 1839. This model was exhibited in 1851 as an illustration of one of our finest line-of-battle ships. Since then she has been fitted with an auxiliary screw propeller, and has had one of her decks taken away, whereby her number of guns has been considerably reduced.

Messrs. Mare also exhibit a model of the steam transport-ship "Himalaya," the largest troop-ship in the British navy.

TROOP SHIP FOR THE LOWER INDUS.

This ship is designed for the conveyance of troops on the Lower Indus, and other of the Indian rivers. She is 375 feet long, 79 feet broad over the paddle-boxes, 18 feet high over the cabins and awning, and draws only two feet of water, while her estimated speed is thirteen miles per hour. The engines are nominally of 220 H. P., effectively of 800 H. P. Her measurement is 3910 tons, and she has accommodation for 800 men and officers.

FIFTY-FOUR GUN "RECEIVER" FRIGATE.

The exhibitor gives to his ship the name of "*Receiver*," on account of her being constructed with a view to *receiving* an enemy's shot and allowing it to pass through her without causing any damage. To attain this object he proposes to build her in the following manner:—The upper or gun deck to have angulated or sloping sides of overlapping two-inch iron plates, which give more strength with but little additional weight. Under the gun-deck is to be a convex iron passage extending the entire length and breadth of the vessel, the sides of which are to be of three-quarter-inch cast-iron plates vertically indented with grooves to half the thickness of the metal where fitted to the ribs, or small squares reaching from rib to rib, so that in every case a shot would knock out a clean square instead of making a fracture. The lower deck of the iron passage to be of one-inch overlapping wrought-iron plates. From the iron passage downwards, the ship's sides are to be of five-inch iron-plates, diminishing gradually to about nine feet below the water-line. The gun-deck to be supported by a number of iron pillars, placed at sufficient distances from each other to allow of projectiles passing between. On the ship going into action the iron passage to be cleared of everything. The ladders and funnels leading from the gun-deck through the iron passage to be protected by three iron cylinders of sufficient strength to resist projectiles. In other respects the ship could be constructed in the usual manner. The advantages which the exhibitor pretends to secure by this plan are:—1st. The decreased weight of iron coating as compared with other vessels. 2ndly. The sides not being-sloped from the water-line, but only from about eight feet above it, allow of the spar-deck being much broader than could otherwise be the case. 3rdly. A sufficient number of iron pillars and plates for the sides of the iron passage could be carried among the ship's stores, so that any damage might be repaired at sea, which could not be the case with large wrought-iron plates.

CAPTAIN COLES' REVOLVING CUPOLA SHIELD.

After the recent engagement between the "Merrimac" and the "Monitor," it will prove interesting to see a model similar to one of the two belligerents.

Capt. Cowper Coles, who is undoubtedly the inventor of this class of ships, submitted his designs and drawings to the Admiralty some years ago; and there is no doubt that, from lectures which he has given on the subject, Capt. Ericcson took his idea of the "Monitor." Still the latter differs from Capt. Coles' vessels in many essential points. The strength of the "Monitor" consists chiefly in the immense thickness of her armour: this naturally makes her very slow and deep in the water, so much so, that it was thought she would be unable to cross the Atlantic with any probability of rough weather.

With Capt. Coles' vessels this is not the case. His cupola shields, or towers, rise about 6 feet above the deck, and are cone-shaped. This reduces the surface for shot to strike on very considerably, when compared with the "Monitor," whose tower is 9 feet high and a cylinder. Each of these "cupola shields" contains two heavy guns, pointing in the same direction, and is made to revolve, so that when the guns have been fired the port-hole is turned from the enemy and the guns reloaded.

A portion of these cupolas being sunk beneath the deck, admits of the armour plates being thinner, viz., 4½ inches, instead of 9 inches, as in the "Monitor."

The weight of one of Capt. Coles' shields is 25 tons without the guns; by doubling this weight, and making it 9 in. thick, it would be practically invulnerable.

One or more of these "cupola shields" can be used according to the size of the vessel.

Captain Coles' plan for rendering the sides of his vessels shot-proof is shown in the section of a ship exhibited by him. By this it will be seen that he proposes having perpendicular sides of thin iron, and inside these, sloping sides thickly plated with armour from the water-line. The object of the perpendicular sides is to give increased breadth to the upper deck when the vessel is not in action, and to prevent her rolling too much in rough water.

ANCHORS.

A model of the description of anchor (Trotman's patent) on board the "Warrior" is exhibited by Messrs. Hawks and Crawshay, Newcastle-on-Tyne (No. 2784).

Trotman's anchor, originated in Porter's, with moveable flukes or arms. One grand object sought to be attained here, was the prevention of fouling by the cable. It was considered, also, that as great injury was frequently occasioned by a ship grounding on her anchor, the closed upper arm would remedy the evil. It was found, however, that the anchor would not take the ground properly as at first constructed, and hence the "shark's fin" upon the outside of each fluke.

An Improved Porter's Anchor is exhibited by C. Martin (2793). This anchor is so constructed that both flukes are engaged in the ground at the same time, by which the following advantages are secured :—

1. It takes hold instantly upon touching the ground.

2. Its holding power is increased a hundred per cent. over common, and fifty per cent. over Trotman's anchors.

3. Having no stock, and both flukes being engaged in the ground, it is not liable to be fouled.

4. It can easily be taken to pieces and stowed with great facility.

The original Porter's anchor has also undergone considerable modification; and, under the name of "Trotman's anchor," has now a conspicuous place.

A competent authority, writing in the *United Service Gazette*, says:—"The general opinion deduced from the series of experiments is, that although Mitcheson's has been so successful, the stock is not at present seaworthy. Trotman's has come out of the trial very successfully, but the construction is too complicated to render it a good working anchor. When once in the ground, its holding properties are very superior; in fact, a glance at its grasp will show that it has the capabilities of an anchor of another construction one-fifth larger. There are, however, drawbacks not easily to be overcome. Its taking the ground is more precarious than with other anchors; and if a ship should part her cable, it would scarcely be possible to sweep the anchor. It is also an awkward anchor to fish and to stow. Yet there are other merits which render it upon the whole, a most valuable invention, and no ship should go to sea without one."

The following Table gives at one view the result of the experiments made by the Admiralty upon breaking the trial anchors, and the time occupied upon each experiment:—

Anchors.	Weight.			Proof-strain.	First Crack.	Broke.	Time in Breaking.
	Cwts.	qrs.	lbs.	Tons.	Tons.	Tons.	Minutes.
Lieut. Rodger's –	19	0	8	19⅞	45	73¼	21
Brown and Lenox's	20	3	14	21½	44½	47	7
Isaac's – – –	21	0	14	21¾	58	63	10
Trotman's – –	21	1	10	21⅞	51	53¼	18
Honiball's – –	20	3	7	21¼	54	75¾	42
Admiralty's – –	20	2	6	21¼	40	56½	26

SHIP-BUILDING FOR PURPOSES OF COMMERCE, AND SHIPS' TACKLE.

Exhibitors, with a few exceptions, those which are found under ships-of-war, range from No. 2646 to 2824.

The mere enumeration of this long list of names would convey but very little information; the reader is therefore referred to the Catalogue.

The models, illustrating the improved lines on which vessels are now built, are particularly numerous.

The Thames Iron and Ship-building Co. (2725) show some of the finest of the Peninsula and Oriental Steam Navigation Company's vessels.

Messrs. Samuda Bros. show models of clipper steamers, among which are the "Leinster," "Victoria," and "Tamar."

Mr. Tovell exhibits models of ships of a new construction, for which he claims the merit of invention. Every section of these, both longitudinal and transverse, forms part of a true circle.

Extraordinary strength and speed are said to be obtained by these means.

One vessel of 491 tons, built upon this plan, with a cargo of 977 tons, is said to have obtained a speed of 17 knots per hour. Another, the "Margaret," of 108 tons, beat the well-known yachts "Phantom" and "Thought" in a run from Erith, round the Nore light-ship and back, which distance she on another occasion performed in four hours and twenty minutes.

The model of the "City of New York," exhibited by Messrs. Tod and McGregor (2727), is a fine illustration of the well-known Clyde-built vessels.

Messrs. Caird and Co., with a model of the North German Lloyd's ship "Hansa," 2991 tons, and the Royal Mail Steam Ship "Atrato," 3466 tons, exhibit some highly finished models of marine engines, on the scale of one quarter of an inch to the foot. One of 160 horse-power for paddle-wheels, and another of 400 horse-power for a screw propeller.

A coloured drawing of the R. M. S. "Persia," made and exhibited by Mr. Kirkaldy of Glasgow, is deserving of great attention. Mr. Kirkaldy, having only devoted some of his spare time after business hours to this drawing, was three years completing it. The skill and labour devoted to its construction are worthy of praise. The "Persia" is represented by various longitudinal and transverse sections even to the smallest details. With this is a pump which involves the general principle of the centrifugal pump, and the Archimedean screw; but it has many novelties. In the shaft of this pump are screws or fans, like those employed to propel vessels, placed horizontally at equal distances, and varying in number with the length of the shaft. In the intervals between the fans are metal screens which are fixed so as to allow the former play-room. The pump is worked by means of two wheels which are turned by hand. These wheels cause the fans to revolve with tremendous rapidity, and the water is lifted up in one continuous column.

MODELS OF SOME OF THE SHIPS BUILT BY J. SCOTT RUSSELL ON THE WAVE-LINE PRINCIPLE SINCE 1851.

Scale $\frac{1}{48}$, or $\frac{1}{4}$ inch to the foot.

Mr. Scott Russell exhibits vessels built by him upon the wave-line principle, including the "Great Eastern," a correct idea of whose size may be formed by comparison with the other vessels shown around her.

This series of models exhibits the scientific lines of a selection of ships constructed on the wave principle, between 1851 and 1862. They are of all sizes, down to as small as 36 tons and 20 horse-power, up to the "Great Eastern," of 22,927 tons, and 2500 horse-power. They also illustrate this very valuable peculiarity in the wave principle, that it may be employed with equal certainty and advantage to the production of ships of the most opposite character and uses. In this series are such vessels as the "Wave Queen," the "Titania," and the "Undine," which are long and fine, meant for speed and pleasure only, without space for profitable work; while the "Baron Osy," the "Victoria," and the "Annette," represent the contrary qualities of great capacity for cargo and passengers, in combination with fair speed, sea-going qualities, and economical consumption of fuel. The "Orleans" and "Lyons" are a remarkable illustration of the way in which the wave principle may be employed to give the rare combination of remarkably fine lines and high speed with the best sea-going qualities; these vessels having continued, during five years, to ply without intermission, summer and winter, between Newhaven and Dieppe even in the worst weather. Some of them, again, like the "Donna Maria Anna," and the "Bann" and "Brune," are vessels of war, built for most opposite purposes, and of most opposite forms, the one a deep, sharp-bottomed, capacious vessel, and the other flat, shallow-water, paddle-wheel gun-boats, designed solely for use in the Baltic. This series, therefore, shows that while the scientific principle, on which these wave lines are formed, is so clear and precise, that the desired speed can be obtained with perfect certainty by precision and proportion of lines—the principle is so plastic that it applies equally to the slowest and most capacious cargo-vessel as to the most rapid and finest passenger ship.

The following is a list of the more important ships built:—

1. *Adelaide and Victoria.*—Iron screw steam-ships of 1852 tons, and 450 horse-power, built in 1852 for the "Australian Royal Mail Steam Navigation Co." The "Victoria" gained the prize of 500*l.* offered by the Australian colonies for the fastest voyage to Australia.

2. *Wave Queen.*—Iron paddle-boat of 250 tons, and 80 horse-power, built in 1852. She is the narrowest sea-going steamer for her length ever built, being 210 feet long and 15 feet beam, or 1-14th of her length.

2. *Titania.*—An iron sailing-yacht of 184 tons, built in 1853 for the late Mr. Robert Stephenson.

4. *Great Eastern.*—Iron steam-ship of 22,927 tons; paddle-engines of 1000 horse-power; screw-engines of 1500 horse-power. The first plate was laid on the 1st May, 1854, and she was launched in January, 1858.

5. *Baron Osy.*—Iron paddle-boat of 792 tons, and 260 horse-power, built in 1855 for the London and Antwerp Trade.

6. *Lyons and Orleans.*—Iron paddle-boats of 415 tons, and 160 horse-power, built in 1856 for the London, Brighton, and South Coast Railway Co., to run between Newhaven and Dieppe.

7. *Undine.*—Iron screw steam-yacht of 414 tons (engine by Messrs. James Watt and Co.), built in 1856 for His Grace the Duke of Sutherland.

8. *Bann and Brune.*—Iron paddle-wheel gun-boats of 287 tons, and 80 horse-power, built in 1856 for the Lords of the Admiralty.

9. *Cleopatra.*—Iron paddle-wheel yacht of 444 tons, and 160 horse-power, built in 1858 for his late Highness Il Hamy Pacha, and now the property of the Sultan.

10. *Rose Diamond.*—Iron screw steam-yacht of 36 tons and 25 horse-power, built in 1859 for George Holland Ackers, Esq., Commodore of the Royal Victoria Yacht Club.

11. *Donna Maria Anna.*—Screw steam aviso of 409 tons, and 80 horse-power, built in 1859 for the Portuguese Government.

12. *Annette.*—Iron screw steam-clipper of 845 tons, and 100 horse-power, built in 1861 for A. Rimington, Esq. She is full-rigged, has a lifting screw, is built on the longitudinal system, and classed A 1 12 years at Lloyd's.

13. A model of a screw yacht of 507 tons, designed on the pure wave-lines, without compromise, by Norman Scott Russell.

PROPELLERS.

Exhibitors.—**J. J. Aston (2646), Fryer (2670), W. Hewitt (2687), R. Griffiths (2683), J. Imray (2690), R. Roberts and Co. (2715).**

The means of propelling ships by steam are illustrated by several models. Mr. Aston shows his disc propeller for which he claims the merit of increased speed and reduced vibration, as compared with paddle-wheel steamers. This propeller consists of two or more circular discs. Like the wheels of a paddle-steamer without the paddles.

A pair of horizontal propellers by Mr. Fryer are a novelty. The floats of these propellers, which are at the stern of the vessel, two in number, turn edgeways when making the backward stroke, so as to offer the minimum amount of resistance to the water. Being situated on each side of the vessel's stern deep in the water, they can be used to steer her.

The feathering screw propellers, exhibited by Mr. W. Hewitt, those by Mr. Robert Griffiths, and Mr. J. Imray, are deserving of attention. The latter especially has produced good results. The entering blade is so formed as to cut the water with but little resistance. The water is driven astern in an unbroken column, which greatly favours the forward propulsion of the vessel.

Captain Symons' "Never Fouling Propeller" is shown in a model of a gun-boat with rounded armour-plated sides, exhibited by Roberts and Co. The peculiarity lies in the machinery for propelling the ship, which consists of two four-flanged tapering screws, which project from the stern of the vessel.

CLASS XII.—NAVAL ARCHITECTURE—SHIPS' TACKLE.

PART II.

SHIPS' TACKLE, RIGGING, &c.

Exhibitors.—**H. D. P. Cunningham (2665), W. J. Gifford (2781).**

The latest improvement in ships' rigging exhibited is that by Mr. Cunningham, of Gosport. This enables a ship's topsails to be reefed without the necessity of the men going out on the yards, which is accompanied with great difficulty in rough weather, and often by loss of life. As Mr. Cunningham makes the tackle in every respect as strong as that used in the ordinary way, this invention is deserving of attention. Many of our merchant ships have been fitted in this manner.

The "gaff-yard rig," exhibited by Mr. W. J. Gifford, is something between the square and the fore and aft rigs, and offers great facilities for sailing close to the wind. The sails are to windward of the masts and gear, and are allowed to "belly" only in the perpendicular direction.

APPARATUS FOR LOWERING BOATS FROM SHIPS AT SEA IN ROUGH WEATHER.

Exhibitors.—**C. Clifford (2659), Wood and Rogers (2799).**

Great loss of life is annually caused by the inefficient means used for lowering boats from vessels when out at sea, or in rough water. By Clifford's system the boat is suspended from four points in the bow and stern, instead of from the keel, as hitherto, whereby the possibility of the boat's "canting" is done away with. In the centre of the boat is a block round which the lowering-line is wound, which is slacked out when the boat is being lowered. This line controls the movements of a roller round which are the ropes by which the boat is suspended. The pendants run through two three-sheave blocks, which serve the purpose of a turn and a half, and prevent the motion of the boat becoming too sudden. On the boat touching the water, the "nip" is taken off the rope by the removal of the weight, the pendants run themselves out, and the boat is free.

Messrs. Wood and Rogers exhibit a model of their plan, which is even more simple. The boat is suspended by four chains, which are fixed by iron bolts in the stern and bows. These bolts are attached to iron rods which run along the sides of the boat, and are worked by a lever placed in its centre. Upon this lever being raised the bolts are withdrawn and the boat is free. Except the lever, the whole of this tackle is entirely free from the danger of being "fouled" by the crew or cargo.

PATENT SPHEREOMETER, FOR FACILITATING GREAT CIRCLE SAILING.

Exhibitor.—J. Solomon (2804).

Mr. Towson, now of Liverpool, some years since directed attention to a fact which had escaped the knowledge of the philosophers, although it was obvious to all the moment the discovery was made. This consisted in demonstrating that the nearest line between any two places on a globe, was the line, or part of a great circle passed round that globe, which cut the two places. We had been so in the habit of looking on the world as projected upon a plane, that we forgot or overlooked this truth.

The principle of sailing on the great circle is now adopted by all, and the apparatus exhibited is to facilitate it in practice.

This apparatus was invented by a Captain Berger in the mercantile navy, and is constructed as follows :—

Kynaston's slip or life-hooks are so contrived that a man at either end of the boat lets go the hook, and the boat is lodged upon the water without tilting.

A hemisphere of slate or white enamel has the parallels of latitude and the meridians for every ten degrees marked upon it.

A quadrant is made to drop into a socket, and work freely on the pole of the sphereometer for the purpose of measuring the great circle distances.

For the purpose of determining the course of the vessel, there is a brass protractor, of the same convexity as the sphereometer, on which are engraved the points of the compass; and in the centre of which is a very small piece of transparent horn, in order to show when the centre of the protractor or compass is over the position of the ship.

DOCKS.

Exhibitors.—G. Rennie and Sons (2710), Rose and Crowder (2718).

G. Rennie and Sons show a model of a floating dock, similar to one supplied to the Spanish Government.

A parallel lift-dock pontoon is exhibited by Messrs. Rose and Crowder. It consists of a square tin pontoon, which is inflated by means of air-pumps.

When not inflated, it lies at the bottom of the dock; the vessel to be raised is floated over it, and the air pumped in, when it is capable of raising 100 tons per minute, or a vessel of 1000 tons in ten minutes.

One of Lloyd's regulations requires that all insured vessels shall be thoroughly examined before going to sea.

This pontoon is to obviate the necessity of their being taken into dry dock; as a vessel can be raised, examined, and refloated in a few hours.

One of these pontoons is now building in the London Docks.

LIGHTHOUSES AND LIGHTHOUSE APPARATUS.

Exhibitors.—Commissioners of Northern Lights (2661), Commissioners of Irish Lights (2660), Corporation of Trinity House (2662).

It may assist the observer if a brief account of the progress of discovery, in this interesting direction, is given for the last century.

The use of mirrors with oil lamps may date back as far as 1763, when, in all probability, the lighthouses at Bidstone and Hoylake were furnished with them. About 1783, the paraboloidal mirrors on a revolving frame were erected on the Tour de Cordnan; and the example was almost immediately and extensively followed in the United Kingdom.

But now the mirror, after many changes, has increased in cost and efficiency. The most primitive form that showed any scientific sense, was the hollow paraboloidal mould, lined with narrow strips of flat quicksilvered glass; and such reflectors are actually still in use at Newhaven. This form was succeeded by parabolic reflectors of silvered copper, in the centres of which were Argand burners, so placed that the rays which struck upon them were sent forward in straight lines towards the sea horizon. Then the very excellent invention of revolving lights was made; by which the whole horizon is successively swept by the beam of light; and, by multiplying such mirrors, a number of beams of light may be made to sweep over the sea. By varying the number or velocity, different periods may be imparted to the flash. The effect of this is, that a revolving light so constructed, appears, from the deck of a ship at no great distance, as a permanent faint light, varied at regular intervals by a much more brilliant blaze; but increase the distance, and gradually only the bright flashes are seen.

The advantages of the revolving lights are that they can be easily distinguished from common shore or ship lights, and serve to distinguish one lighthouse from another.

Argand, fifty years ago, suggested a combination of the parabola and ellipse, and Handry, of the cone and parabola, as preferable for these mirrors; but they have not been put to the actual test. Borclier Marcier invented some ingenious modifications of the parabolic mirror, which were adopted for the harbour lights of France, but have been discontinued; the only place where it was used in the British Isles was at Littlehampton.

The simple parabolic silvered reflector still holds its ground in the United Kingdom, which used to stand pre-eminent for its efficient beacon lights amongst the nations. Its best lights still stand a very favourable comparison with those o foreign countries. Such a light is that at Beachy Head, where thirty burners, consuming 1000 gallons of oil annually, are arranged on a triangular stage, in such a way that ten reflectors at once direct a beam of ten-fold brilliancy to the same part of the ocean.

Still, however, some of the rays of light were wasted in travelling to the sky or to the sands; to obviate this, lenses to concentrate the rays were tried, but proved to be a failure, as it destroyed the effect of the revolving mirror. Buffon and Condorcet proved that this need not be the case, but nothing was done until Auguste Fresnel took it up, by order of the French Government. He was strongly in favour of the use of lenses, and in 1822 he brought forward his proposition for surrounding the flame of a gigantic lamp, by lenses made in many rings of crown glass, subtending an angle of forty-five degrees; by this means he gathered about one-third of the whole light into a few sheafs of ray, which could be easily made to revolve, and the light which radiated above these lenses was sent along the surface of the sea by a combination of mirrors and lenses. This apparatus was proposed to and accepted by the French Government, and carried into effect all around the coast.

The Dutch first followed this good example, and, ten years after (1835), it was first used in Great Britain, at Inchkeith, in the Frith of Forth. After this these lenticular arrangements were adopted in many of the lighthouses, and are gradually replacing the silvered reflectors. The United States and Spain have entirely adopted this lenticular arrangement, in the centre of which should be the most powerful flame ever produced. For economy, attempts have lately been made to use pressed glass, instead of ground, for these lenses, but we cannot say they have been successful.

Mr. Thomas Stevenson has made the following important modifications of Freshnel's idea: the rays passing above or below the band of lenses, are caught and sent into the desired direction, by totally-refracting prisms of glass. If it is desired not to illuminate the whole circle, and to send a particularly bright beam in one or two directions, the rays are caught by lenses and a row of vertical prisms, and sent direct to the desired spot.

An effective combination of the metallic reflector and the lens is in some places adopted, where the rays in front are parallelized by the transparent glass, and the rest by the parabolic metal, with the exception of those at the back of the flame, which are returned through it by a spherical mirror, and sent through the lens.

The proper adjustment of these lenses is of the utmost importance, and an inquiry was made into this matter by Mr. J. F. Campell, when it was found that in many instances the adjustment was so imperfect that the prime object was defeated.

The same optical apparatus is applicable to a gas as to an oil flame; but though gas is used with great success in some of our most important harbour-lights, it has been rejected by the lighthouse authorities as being dangerous.

The *electric light* is produced by a powerful current of electricity passing through conducting wires, the points of the wires placed slightly apart, and terminating in charcoal points. Such a light has been used at South Foreland, but was removed, as the dioptric apparatus was ill adapted for it; now the lamp is at Dungeness, with optical apparatus of its own.

A light, produced by the incandescence of a piece of lime in an oxy-hydrogen flame, as first employed by Captain Drummond, was introduced into the lighthouse at South Foreland, as an experiment, which was not successful. The apparatus of this light is exhibited by W. Prosser and H. J. Standly, in Class XXXI.

The models of lighthouses and lighthouse apparatus, exhibited by the Commissioners of Northern Lights, show the great care and attention devoted by them, to guard our mariners from the dangers by which our coasts are surrounded.

Among the former is a model, showing the manner in which the Bell Rock Lighthouse, Port Hamilton, was built. This Lighthouse is situated on a reef of rock twelve miles from the land, and covered by sixteen feet of water at high-water mark spring tides.

The models of lighthouse apparatus show the various improvements that have been introduced.

The first is a "parabolic reflector," the first attempt of the kind used in Scotland. It consists of a number of small pieces of mirror, placed in a metal reflector. This was a great improvement upon the old lights; yet, from the great number of the pieces, it was difficult to bring them all to one focus, whereby much of the light was lost.

The fixed azimuthal light has a row of vertical prisms at one side, intercepting the rays of light, which would otherwise be lost on the land side, and throws them out to sea. This plan is also used for the purpose of indicating a channel, or dangerous rocks, when it is not practicable to have a lighthouse on them. One of these prismatic reflectors is placed on the dangerous spot. It receives its light from a lighthouse on shore, which may be two hundred yards distant, and then throws it out at the angle at which the prisms are made.

The dioptric holophotal apparatus, constructed by Mr. Thomas Stevenson, illustrates the manner in which rays of light pass through glass. This apparatus consists of a lens, surrounded by circular prisms, placed in a glass globe, the inside face of which is perfectly smooth, while outside it has a number of prisms. A red ball is placed in the focus of the latter, and to an observer it appears entirely filled with red, the effect of the light; but if turned round the ball will no longer be visible, although the wire on which it is placed can be seen.

This apparatus has been found to condense the rays of light much more powerfully than a metal reflector.

A new parabolic reflector, in which a powerful lens, composed of prismatic reflectors, is introduced, also condenses the rays of light very well.

Fresnel's fixed light was one of the first in which a set of upper and lower prismatic reflectors, which collect the rays of light, and depress them to the horizon, was adopted. This revolving light, with which the Skerryvore Lighthouse was fitted, has eight square lenses set round the centre. The rays of light that would escape above, are thrown back by an equal number of inclined mirrors, while the lower portion of the light is diffused equally to all parts of the horizon.

Thus there are two lights—that diffused through the lower reflectors, which is steady, and that diffused through the eight square lenses, which revolves.

Thomas Stevenson's holophotal revolving apparatus is an improvement upon this, and has been universally adopted. The chief difference is, that the lower set of reflectors turns with the lenses, so that there are clear flashes and total darkness, which repeat themselves every ten seconds.

The Dioptric Revolving Apparatus, exhibited by Chance Brothers, in the Nave, is made according to the system known as that of Augustin Fresnel, with the holophotal modification of Mr. Thomas Stevenson, by whose improvement the flash is extended to the series of totally-reflecting prisms above and below each of the lenses; this effect being produced by simply making the prisms concentric with the polyzonal lens, so that the prisms become lenticular in their action, and parallelize diverging rays horizontally as well as vertically.

This arrangement was not exhibited in 1851; but another mode of producing a similar effect was displayed on that occasion, in which the diverging rays were parallelized only vertically by the reflecting prisms, and had to pass through a second series of prisms, in order to be parallelized horizontally.

It must not be forgotten that these exhibitors are the only persons who have succeeded in establishing in this country the manufacture of dioptric apparatus for lighthouses.

The lamp of Chance Brothers comprises several improvements recently introduced in the construction of lamps for lighthouses, viz. :—

(1.) The piston which forces up the oil into the burner is pressed downwards, and at the same time maintained in a horizontal position, by means of guide-rods, communicating with weights beneath the oil cistern.

In similar lamps, as hitherto made, the weights are placed upon the piston itself, in which arrangement not only is there great practical inconvenience, but also the piston is liable to be pressed on one side more than on another.

(2.) The cylinder containing the oil is made of one casting; hitherto it has been made of a sheet of metal joined by soldering, and therefore liable to leakage, and not so durable as when cast in one piece. Also this cylinder is accurately turned in a lathe, which facilitates the true action of the piston.

(3.) The oil is supplied to each wick separately: previously all the four wicks were supplied by one common pipe only.

The lantern and lightroom is exhibited as a specimen of improved construction :—

(1.) By uniting wrought iron with gun metal in the standards of the lantern, instead of making them of gun metal only, the greatest strength is combined with the least interception of light.

(2.) By means of accurate fitting at the joints, the lightroom is rendered as rigid as possible; and also an outer gallery is added, to facilitate the cleaning of the lantern panes externally.

In the clock-work, for causing the apparatus to revolve.

In this rotatory machine is introduced, for the first time, in connection with lighthouses, a contrivance communicated by Professor Airy, by which the force exerted in winding up the weight is made to react upon the clock-work, so as to maintain the proper speed of revolution during the time of winding up.

The revolving azimuthal condensing light is also an invention of Mr. Stevenson. It has three revolving mirrors, which intercept the rays diffused towards the shore, and throw them back into the lens.

A mechanical pump lamp completes the most interesting portion of this exhibition. This apparatus is made to wind up like a clock. Four bags of skin, which draw out alternately, pump the oil from the cistern to the burner. A small bell is rung when the machinery is nearly run out.

The model of Fastnel Rock Lighthouse is exhibited by the Commissioners of Irish Lights (2660). It is about 4½ miles S.W. of Cape Clear, and was designed and built by Mr. G. Halpin, in 1854.

The Corporation of Trinity House (2662) exhibit models of lighthouses, erected by them in various places.

Foremost of these are the Small's lighthouses. One of these is 146 feet high. The Bishop Rock Lighthouse, on the Scilly Isles, is 110 feet high.

The South Stack House, built on a small island, is also shown, with a bridge, forming the communication with the shore; together with many others, of which we will merely notice the Air Point, Gunfleet, and Maplin Sands Lighthouses, which are constructed on piles sunk deeply into the sand, those of the latter being screwed in to a depth of fourteen feet.

LIFE-BOATS, AND LIFE-SAVING APPARATUS, &c.

Exhibitors.—**P. A. Halkett, High Holborn (2747), J. Hamley, Lisson Grove (2748), Hawkesworth and Annesley, Lincoln's Inn Fields (2749), W. Hutchins, Greenwich (2750), T. P. Jordeson, Eastcheap (2751), T. Learwood, Truro (2752), G. Peacock, Starcross (2796), W. Rich, Bloomsbury (2798), Royal Humane Society, Trafalgar Square (2801), R. Smith, Fish Street Hill (2803), Capt. Ward, R.N., New Brentford (2810), H. Richardson, Aberhirnant, Bala, N.W. (2755), The Royal National Life-boat Institution (2756).**

The description of life-boat here represented on its transporting carriage is that which after long and severe trials has been found best adapted to the work it has to perform, and is in use at all the stations of the Institution.

Its chief advantages are—increased speed against a heavy sea; the quality of self-righting when capsized; plenty of room for rescued persons, and immediate discharge of any water shipped. The latter result is obtained by "self-acting relieve-valves," which can only be opened by pressure from above. These valves are in the bottom of the boat, through which they let the water escape.

In the year 1861, 4,624 lives were saved by boats of this description. The gold and silver medals awarded by the Institution for saving life are also shown; also a barometer-indicator, which by means of glasses can be seen at several miles distance.

A wreck chart of the British Isles, for 1861, shows where 1,494 wrecks, accompanied by a loss of 884 lives, have taken place in one year.

An *Iron "Tubular Life-Boat,"* exhibited by Mr. T. Richardson, was invented in 1830 by the late H. Richardson.

The "Challenger," built on this plan in 1851, performed the journey from Liverpool round the Land's End to London, in fulfilment of a challenge to all the life-boats in the kingdom.

This boat will neither upset, sink, swamp, or be water-logged, draws merely a few inches of water, will beach through any surf and go off again, and can be sailed with safety. A boat of this kind rescued a ship's crew when the Liverpool life-boat, in trying to put out, was capsized, and her crew, thirteen in number, drowned.

The "Poncho Mattresses," the invention of Captain Peacock (2796), also promises to become useful. It is like an ordinary mattress, stuffed with hair and cork, and made to double in half. An opening is left through the canvas that connects the two parts through which, in case of shipwreck, a person's head is thrust; the mattress is then strapped round the waist, and otherwise secured. By this contrivance the body is kept in a perpendicular position, half above water. It has four pockets in front, to carry valuables, and, if necessary, provisions.

An experiment was made to test the floating powers of this contrivance, when it was found that it would freely support a man, with the weight of two thousand sovereigns in the pockets.

Mr. Birt exhibits a model illustrative of the advantages of the rocket and mortar apparatus in case of shipwrecks. It represents a stranded vessel which is fast breaking up—a line has been sent on board by means of a mortar apparatus, and one of the crew is being drawn on shore, suspended under the armpits by a life-buoy.

A description of the projectile used for this purpose has been given in Class XI. It is recorded that 1,830 lives have been saved by this apparatus.

BOAT-BUILDING FOR PLEASURE AND RACING BOATS, &c.

Exhibitors.—**E. Ayling, Lambeth (2743), W. Biffen, Hammersmith (2744), H. Cannon, Blackwall (2745), N. Thompson, Rochester Road (2759), E. Searle, Lambeth (2757), Watson and Davison Munster Square (2761), A. Wentzell, Lambeth (2762).**

Models of racing boats and their appliances are exhibited by Mr. Searle, who also shows a model of the state barge. Mr. Biffen shows an ingenious manner of overcoming the difficulty of packing and transporting racing and yacht boats. The former can be divided into three parts, which can be refixed with but little trouble. The latter divides in two down the middle: the two halves are fastened together by means of screws and nuts, and the fissure made water-tight by means of an india-rubber lining. Ayling has some beautiful racing oars and skulls.

BOAT-BUILDING BY MACHINERY.

Mr. N. Thompson (2759) has a case containing a series of models of machinery, by which a boat can be built in a few hours from the rough log.

This machinery does great credit to the mathematical knowledge of the inventor, and is not confined to boat-building merely, but also applies to barges, lighters, and yachts.

It is said to accomplish, in five hours, what by hand would take five days to complete.

The first step is to take the rough timber, which is cut either straight or in taper form into the various requisite shapes, by an ingenious improvement on the circular saw. A number of planks, afterwards to be cut up into ribs, are steamed into a semi-flexible state, and in this condition are bent over iron frames representing the outer sections of a boat's side. Held firmly in this shape they are dried, and retain for ever the curve or form to which they have been moulded. In the workshop are kept certain standard patterns of boats of all sizes made by the machinery, each part of which is numbered, and perfect accuracy with the outline and form of which is required in all portions of boats of the same size. The machine for sawing the ribs in parallel lines, with a true bevel as to curve, is entirely new and simple; but one of the most curious is the planking curvilinear saw, giving to the inner and outer side planks the varied local curvature required for each different part of a boat. The plank is sawn to width, and marked in chalk figures from 1 to 8, from the numbers on the standard boat in the workshop. This passes through a double cutting and planing machine. The cutters are conical in shape, the upper being convex, and therefore grooving out the plank concave, and the lower *vice versa*. These are laid horizontally, but, on a movable axis, capable of being turned backwards and forwards on an index scaled from 1 to 8, according as the chalk figures in the plank enter the machine. Thus, by keeping the cutters transverse to the plank, the curve is slight, but turning them longitudinally gives the whole depth, and so a rough board passes rapidly in at one end and emerges at the other curved inward and outward with mathematical certainty, and not only curved, but planed and bevelled at the edges. The machine completes 30 feet of oak plank in four minutes, or 150 streaks for the day of 10 hours. On the same scale, a workman only completes

20 bevelled ribs a day, while the machine turns out 500, with only two persons to superintend it, who, so far from being skilled workmen, may be mere boys, to stop or start the steam. The diagonal cutters for forming the irregular bevels of any angle, for the stern-pieces, stem, &c., are equally quick with their work, doing in one minute what requires two hours to accomplish by manual labour. The gratings are cut of any size or width, by the motion of what is called a "drunken saw." This is simply a circular saw fixed at whatever angle with its axis it may be required, and which, with its teeth arranged in four different ways, cuts at any inclination, either simply sawing through a plank when straight, or making a gap two inches wide, if necessary. The number of boats built in the United Kingdom each year amounts to upwards of 21,000. By this new machinery, erected in a building 100 yards long by 50 wide, it is stated 60,000 boats of all sizes, from an outrigger up to a line-of-battle ship's barge, could be completed in one year. Whether the increased facilities in the way of cheapness and quick manufacture will stimulate the boat consumers to a larger consumption, remains to be seen. This much Mr. Thompson's beautiful machinery seems certainly able to effect, and such a profitable result in itself almost repays the eighteen years' hard labour he has had in gradually bringing his mechanism to its present perfection.

COMPASSES.

A set of ship's compasses, such as are in use in the Royal Navy, are exhibited. One of these is of improved construction. It is filled with highly-refined spirits of wine, in which the dial floats. This prevents the too great oscillation of the compass when the ship is in rough water, and consequently removes the errors arising from vibration.

WALKER'S SHIP LOG AND SOUNDING MACHINE.

In this log the register and rotator are combined. By this arrangement, not only is the machine made more compact, but the end of the rotator is protected from all end pressure, thus considerably reducing the friction, and thereby enabling the log to register *with equal accuracy at all speeds.*

As in a geographical or nautical mile there are 6120 feet, if we divide that number by 60 (as the hour is divided into 60 minutes) it will give us 102 as the number of feet there are in the sixtieth part of a mile, and *this* we will call a minute-knot, as it is the same proportion of a mile as a minute is of an hour.

The body of the instrument does not revolve as it passes through the water, but contains the wheel work for registering the number of revolutions of the rotator, which is caused to revolve, as it passes through the water, by the oblique position of the vanes attached. The angle of the vanes is so adjusted to the wheel work of the register, that when the machine has passed through the tenth part of a mile, or, in other words, through six minute-knots, the finger of the 1st dial will have made one revolution; the finger of dial No. 2 will have made one-tenth of a revolution; and the indices 3 and 4 will both have moved proportionately. The first index goes round in six minute-knots, or the tenth part of a mile; the second goes round in 60 minute-knots, or 1 mile; the third in 10 miles, and the fourth in 100 miles, or 6000 minute-knots.

When the machine is required to tell the present speed, it should be held over the side of the vessel at the end of a long rod, which should touch the water, with a 5 or 6 fathom rope, for a definite number of minutes, when the present speed may be found.

The sounding machine is devised on the same principle. The inclined vanes revolve as the instrument descends, and the rate of revolution is recorded upon a dial, as in the log.

Class VI.—Carriages not connected with Rail or Tram Roads.

Number of Exhibitors, 96.

Situation of Class.—*This Class extends along the permanent building, under the Picture Galleries, from the South Eastern Tower to the Central or Cromwell Road Entrance,* The United States *occupying the space in the Eastern Tower.*

The plan of this Court, since it would prove no guide to its arrangement, is omitted.

In most of the other classes it has proved convenient to group the various articles exhibited, under different heads, but in this class it is difficult to do so. The difficulty arises from the variety, and this will be evident, by a glance at the following list of the names of carriages kept by an eminent London firm, and such as are in constant demand.

In giving an account of the carriages exhibited, we can mention such only as are marked by some peculiarity in construction or mode of manufacture. It does not, therefore, follow that such carriages as may not be named are not equally excellent with—indeed they may be superior to—those which happen to be described.

LIST OF CARRIAGES IN USE IN 1862.

Town Coaches.
Town Landaus.
Town Chariots.
Barouches.
Driving Coaches.
Light Coaches.
Omnibuses for private use.
Barouche Landaus.
Sociable Landaus.
Sefton Landaus.
Elcho Landaus.
Sociables.
Pony-Sociables.
Light Barouches.
Buggies.
Single Broughams.
Double Broughams.
Segmental Broughams.
Miniature Broughams, with hicory wheels.
C spring Broughams.
Brakes.
Waggonettes.
Mail Phaetons.
Sporting Phaetons.
Light road Phaetons.
Dog Cart Phaetons.
Stanhope Phaetons.
T Carts.
Tilbury and Spider Phaetons.
Cab Phaetons.
Park Phaetons.
Cabriolets.
Gigs.
Dog Carts.
Sleighs.

To these dress carriages and carriages for special purposes may be added.

CARRIAGES.

Exhibitors.—I. Aldebert (1338), A. Andrews (1339), H. Angus (1340), Bennion and Healey (1341), H. Black and Son (1342), Booker and Sons (1343), R. J. Boyall (1344), G. Briggs and Co. (1346), J. D. Chantler (1352), J. Cockshoot (1354), W. Cole (1355), Cook and Holdway (1356), Corben and Sons (1358), E. Cousins (1359), Davies and Son (1362), Davies and Sons (1363), Edwards, Son, and Chamberlayne (1364), W. J. and C. Felton (1367), W. Findlater (1368), J. Fuller and Sons (1369), S. and A. Fuller (1370), J. T. Glover (1372), S. W. Hale (1374), Hall and Sons (1375), J. Harvey (1376), H. and A. Holmes (1381), Hooper and Co. (1383), C. Horsley and Son (1384), F. Houlgate (1385), J. Hutton and Sons (1388), Ivall and Large (1389), E. Kesterton (1391), W. Kinross (1392), C. Lenny and Co. (1395), McNaught and Smith, (1397), J. Macnee and Co. 1398), J. H. Mann and Co. (1399), H. H. Mason (1400), F. Mulliner (1402), H. Mulliner (1403), E. Newham (1404), Newnham and Son (1405), Nurse and Co. (1407), R. and J. Offord (1408), Pearce and Countze (1413), Peters and Sons (1414), J. E. Ridges (1417), Rigby and Robinson (1418), Rock and Son (1420), J. Rogers (1421), W. Rogers and Co. (1422), Seadon and Jones (1424), J. A. Sellers (1425), R. H. and F. Shanks (1426), J. Shepherd, (1427), J. Silk and Sons (1431), T. R. Starey (1434), Startin and Mackenzie (1435), Stevenson and Elliot (1436), F. Stocken (1437), G. Thomson (1439), W. Thomson (1440), W. and F. Thorn (1441), Thrupp and Maberly (1443), H. L. Turrill (1444), R. and E. Vezey (1445), G. Waters and Son (1447), Watkins and Hornsby (1448), C. S. Windover (1451), Woodall and Son (1452), Wyburn and Co. (1454).

Hooper and Co. exhibit several varieties of carriage, amongst others may be named a light and elegant "Craven" barouche, hung on under and C springs, with a perch of improved construction, made of wood so connected with iron by rivets and hammered edges as to act on the principle of a tube, with a tough wooden centre, combining lightness with greatly increased strength and safety: the advantages of this plan will be at once evident to all persons acquainted with the recent advances made in the application of wrought iron. By the construction of the body, the commodious folding-steps are so placed as not to be seen above the panels, thus enabling the latter to be made of a more than usually light and elegant form; it is also suspended at such a distance from the ground as to protect the occupants from the dust of the road. With the improvements introduced in the general construction of the individual and combined parts, and by the use of very tough steel instead of iron, where practicable, the utmost strength with the minimum of weight is obtained. The carriage is an example of the most recent improvements and combinations, to effect elegance, lightness, and ease..

They also exhibit a light pair-horse "Sefton" landau; the improvements in this carriage are on the same principle as those of the barouche. The drawbacks hitherto considered inseparable from landaus (weight, and partial opening of the head), are overcome in the carriage exhibited: the head, by a very simple and efficient method of construction, is made to open as flat as a barouche, thus forming, when open, a very airy carriage, and, when closed, a comfortable family carriage, equally adapted for London or country use.

A series of carriage drawings, coloured and drawn by J. Gilfon from the original designs (to the scale of ¾ of an inch to the foot) by George N. Hooper, are an illustration of the combined efforts of the artist and practical constructor.

H. and A. Holmes exhibit a Sociable landau with polished steel perch hung on C springs. The metal and wood-work of this landau have been polished to show the excellence of the workmanship and desirability of cast steel for the springs.

A family landau, by Silk and Sons, on horizontal springs, is well designed and finished. It has a hind seat which is so placed that its occupant does not suffer any inconvenience from the head when laid down.

Corben and Sons' "Diaropha" is a sociable barouche, which, by fixing on a Clarence top, is converted into a close carriage. The hind part is hung on Corben's inverted C springs and leather braces. These, though lighter, render it as easy as if it were on a perch and ordinary C springs.

C. Windover shows his "Tessatempora," a carriage that can be formed into a barouche, a sociable, a coach, or a landau, for which purpose it is furnished with three different heads, that can be easily moved. It is very complete in all its fittings.

Evans shows a Hansom cabriolet for private use, in which he has introduced several important improvements. The first of these is the application of metallic springs to the shafts, near their junction with the front of the vehicle, securing a combined action, by which he removes the unpleasant motion of vehicles of the usual construction. The weight of this carriage is also considerably reduced, weighing only 6½ cwt., whereas the usual weight is 8½ cwt. These, with a considerably lessened draught, form the chief advantages of this cabriolet.

S. Fuller exhibits a Brougham with glass front, which is also deserving of attention on account of its lightness, its weight being under 7 cwt.

R. Boyall's phaeton is well adapted for ladies' use. It combines tasteful design with great lightness and strength. It is hung upon inverted C springs.

A vehicle bearing the strange name of "Gorilla Cart," by Burnett, is constructed on the dog-cart principle, but is hung so low as to be quite safe in case of accidents. Its chief peculiarity is the large basket-work wings that protect the sides from dirt, which, when worn out, can be easily replaced. Like Boyall's phaeton, it is well adapted for ladies who drive.

Messrs. Rock and Son, of Hastings, exhibit a carriage in which, by a further development of the principle of interchangeable heads, invented and patented by them, they combine the Diorohpa with the Sociable Landau; thus, one carriage may be used either as a coach, a landau, or a barouche; or any two of them may be combined, and the third omitted. The landau head as exhibited in this carriage shows many improvements which are applicable to the Landau, *pur et simplé*. An improved step of general utility may also be noticed. In finish, Messrs. Rock and Son's carriage is rather of a quiet character as to the painting, in which, however, a simple but effective arrangement of well-known colours is made to produce a novel and pleasing result. This carriage is well adapted for country use, as it can be used in all weathers.

Rogers and Co. exhibit their "Registered Clifton Waggonette," one of the most elegant and novel style of carriages of this class yet introduced; it is capable of being transferred into four distinct equipages, viz., a waggonette, driving-phaeton, dog-cart, and a close carriage: the elegant sweeps of the iron-work, and novel method of transforming it from a single to a pair-horse carriage, the lightness and ease of the springs, the peculiarity of ascent to the body, and the power, when used as a close carriage, of raising or lowering the canopy top, altogether recommend it as one of the most unique and useful carriages. This waggonette also has two sets of springs resting on india-rubber, which greatly reduces the motion when driving over rough roads.

McNaught and Smith have a waggonette of similar construction, with the addition of a folding-step over each of the front wheels. These steps slide into the panel of the carriage, and are completely hidden when not used. Another waggonette is that shown by G. Thomson. It is also available as a dog-cart, and covered or open waggonette. It has a very serviceable drag or break, which acts upon both wheels at the same time. The roof is moved off with the greatest ease, by means of a stand, which can be applied at any place. This waggonette is very light and roomy.

H. Mason exhibits a waggonette for eight persons, with removeable head, which is of good workmanship and finish. With a description of one shown by Newnham and Son, we will conclude our account of the waggonettes, a style of vehicle introduced since the Exhibition of '51. This one has two heads, which however meet sideway, and not like those of the landau. This head, which is a falling one, is so arranged that it draws in when lowered, and does not overlap the wings, thereby being sheltered from the dirt thrown by the wheels. It is roomy and well-built, but somewhat heavy.

Simpson's "Patent Drag," built by Messrs. McNaught and Smith, is a vehicle on two wheels, designed to carry four, six, or eight persons. It can be used as a dog-cart, by lifting off the side seats. This will prove valuable for shooting purposes, as it has ample accommodation for dogs or luggage. The oscillation is greatly reduced by perpendicular india-rubber springs. Its weight is between 7 and 8 cwt.

Davies and Sons have here a superior build of a light trotting phaeton, hung upon a perch carriage, constructed for the wheels to pass under body, and made suitable for ladies, with neat folding-steps. It is completed with axles of Collinge's patent and wrought iron, case-hardened boxes, tough steel tyres to wheels, and iron-work of carriage. Weight altogether 4¼ cwt.

Messrs. Newnham and Son have a light landau waggonette with folding leather head, having side, front, and hind glasses, to drop into body; it forms an open or close carriage, perfect in either form. The head being always attached to the body, and being easily opened or closed, affords great convenience, whilst by an improved arrangement of interior seats, the riders can sit either *vis-à-vis*, or with face or back to the horse, thus combining the accommodation of the sociable landau, with the compact formation and lightness of the waggonette. Messrs. N. and Son have invented an improved neck-plate, which being attached to the side slabs of the head, shortens the same when lowered, and thus the head lies perfectly flat, without protruding beyond the wings of the body.

T. R. Starey, of Nottingham, exhibits his Granville landau, clipper shape, which forms a perfect winter and summer carriage, for a pair of light riding-horses; the head by a new arrangement falling lower than has hitherto been accomplished, and quite flat. It is strengthened throughout with steel instead of iron, whereby a maximum of strength with a minimum of weight is obtained. It is hung on highly elastic springs with india-rubber bearings, and Messrs. Jas. Apperley and Co.'s "patent silent wheels," with chain tyres bedded in india-rubber, are adapted, a combination that insures greater durability to the wheels and carriage, as well as secures a remarkably soft, easy, and noiseless motion. The doorway is unusually wide, to suit the present style of dress, and while giving a very large window on each side, the riders are not unduly exposed to view. The steps and doors are self-acting. The colour of this carriage was designed by Owen Jones, Esq.

Parson's patent wheels should also be examined. Amongst the advantages possessed by this wheel may be mentioned, cheapness in first cost, the simplicity of its construction, whereby the greatest strength is secured with the least amount of material, its applicability to all purposes, and its non-liability to injury or disarrangement by variation of temperature or other atmospheric influence.

The nave is cast from metal expressly prepared to bear great strain with as small amount of friction as possible. The spokes are of best malleable iron, the inner ends are attached to the nave, and the opposite ends have a boss or nut screwed firmly on to support the felloes. The ends of the spokes fit tightly in small augur holes in the felloes, thereby avoiding the large mortice holes which prove so destructive to the ordinary wheels. By this arrangement great strength is secured and the load equally distributed on the felloes and spokes. They are bonded either with whole bonds shrunk on, or streaks or segments put on in the usual way.

OMNIBUSES AND CABRIOLETS.

Exhibitors.—C. J. Case (1351), J. Evans (1366), C. Hadley (1373), G. Shillibeer (1429).

G. Shillibeer was the introducer of omnibuses into this country. The writer well remembers the excitement attendant on the first appearance of a vehicle, now so common, of this description, in the New Road: it is therefore interesting to find Mr. Shillibeer an exhibitor in 1862.

His patent omnibus has been designed and constructed expressly with a view to meet the public exigencies, having regard also to the interests of the proprietors themselves. It will carry twenty-three passengers (exclusive of the driver and conductor,) nineteen of whom will be protected from the inclemency of the weather. The dimensions correspond, substantially, with the present omnibuses, and its weight having been found to be a ton, is much lighter than many omnibuses now in use.

The arrangements and advantages of this patent omnibus are as follow:—It is divided into two compartments, namely—the front compartment is arranged with seats for seven passengers only, who sit in the same way as in the present vehicles. The entrance to this compartment is by a clear passage from the door, which is at the hind part of the carriage as usual, thereby avoiding annoyance to the other passengers, as well as the present inconvenience of reaching a seat, and the hind compartment is arranged with seats for four passengers only; two of them sit *vis-à-vis* on the left-hand side, and the other two, in the same manner, on the right-hand side of the carriage, leaving a clear passage between these *vis-à-vis* seats, from the door to the entrance of the front compartment. Each passenger in this hind compartment has a separate and comfortable seat, equal to an easy-chair, or first-class railway-carriage seat, and all inconvenience of ingress or egress for passengers is thoroughly prevented; added to which, the frequent robberies hitherto complained of in omnibuses will, in this compartment in particular, be impossible; this will also be the case on the centre outside seats. The patent omnibus will carry twelve outside passengers with comfort. From the centre of the interior eight of the outside seats are reached by easy steps on either side of the above-named passage, thus: the passengers enter at the door, pass along the passage, and ascend to, or descend from, those exterior seats, not only with perfect ease and facility, but free from danger or risk of accident.

The passengers occupying these eight outside seats are covered by a light hood, which is drawn over or let down with the greatest facility; so that those passengers will be protected from the weather as much as if they were in the interior of the carriage. On a wet day nineteen instead of only twelve passengers can be accommodated, thereby, on such occasions, increasing the receipts of the proprietors by more than one-third. The only passengers exposed will be the four who, as in other omnibuses, are seated on each side the driver.

C. J. Case exhibits a model in which he shows a new style of window, and an easy mode of ascending to the roof. Mr. Evans shows a modification of the Hansom cabriolet; and Mr. C. Hadley has a series of drawings of carriages of different descriptions.

CARRIAGE FITTINGS, WHEELS, &c.

Exhibitors.—**Clarke Brothers (1353), Cooper, Blackford, and Son (1357), Dart and Son (1361), R. Gittins (1371), J. Hawkins (1377), C. Higginson, jun. (1379), C. Higginson, sen. (1380) Holroyd, Noble, and Collier (1382), W. J. Howitt (1386), F. Hutley (1387), W. Jones (1390), G. Parsons (1410), E. Partridge (1411), T. Paterson (1412), Reay and Usher (1415), W. Robins (1419), J. Sherwin (1428), J. Short (1430), H. Strickland (1438), J. Whittingham and Wilkins (1449), F. Wickstead (1450).**

The more important of the wheels exhibited are those made on Apperley's patent by T. R. Starey.

These patent silent wheels differ from most others, and can be recommended with confidence; a set exactly similar to those exhibited on the carriage having been working on rough stones and roads for the last twelve months without the slightest defect being perceived.

The appearance of this wheel is so near that of the ordinary kind, that unless the attention is called to it, it would pass unnoticed. It is made of Canadian hickory, on the American principle, a stout flanged tyre binding all firmly together, inside of which india-rubber is laid. Inside this flanged tyre, a flat chain is fitted as a wearing tyre, the surface being but half the usual width. It will thus be perceived that the wheel without the two latter tyres is stronger than ordinary. The india-rubber forms a bed for the chain, which with its slightly yielding action, and the elasticity of the india-rubber combined, completely absorb the shocks from the road at their very beginning. The effects produced are, the noiseless revolution of the wheels, the lessening of vibration in the carriage, and a greater durability. These wheels are applicable to any kind of carriage, and old wheels can be altered to this plan so as to be as effective as new ones.

The machine-made wheels, manufactured by Holroyd and Co., are well constructed, and the wheels by Parsons strongly put together. The tubular shafts of iron exhibited by Clarke Brothers give at the same time lightness and strength. The axletree of Mr. Gittins has much to recommend it, while the arms, axletrees, &c., of Mr. Hawkins show careful workmanship. Howitt's springs and smith's work generally are to be commended, and the mail-carriage axletrees of Partridge are of the best character. The axle-block forgings of Reay and Usher are examples of most careful workmanship. There are other exhibitors who show carriage fittings of good character, but they do not appear to advance anything novel. The carriage laces are, many of them, very elegant in design, and all of them good in execution. The specimens of heraldic painting and of other decorations for carriages will be considered as admirable examples of this kind of art, and the ornamental works generally serve to mark in this, as in other sections of the exhibition, an improved taste.

PERAMBULATORS, &c.

Exhibitors.—**H. L. Burton (1348), T. W. Cross (1360), J. La Roche and J. Mehew (1394), J. B. Smith (1433), J. Ward (1446), J. Newton (1406).**

There is not much to be said respecting this class of carriages. The Bath chair for the infirm is a construction of considerable utility. The perambulator, as it has been employed for some years past, is of a very questionable value. Children require not merely air, but exercise; and it is to be feared that the introduction of those little convenient carriages has tended to deprive them of much of this. Many of the chairs and perambulators are of the most elegant description, and appear to be very carefully made.

The velocipedes of Mr. Sawyer are exceedingly ingenious—especially in the conversion of the muscular power into the necessary propelling force. A gentleman's velocipede appears to possess all required advantages. It is adapted for sketching, angling, shooting, or as a private carriage; the fittings for sketching-board are in front, between the two front wheels, fixed by a thumb-screw from the bottom of a seat board. Behind the seat is a box to carry the drawing utensils, and attached to this box are two iron stays to carry a tin box, in which may be placed a wrapper or macintosh. Between the seat and the box behind, there is a stay, and a socket screws on to it, to carry an umbrella. When the umbrella is not required, it can be placed under the perch, where at any time a fishing-rod and basket, or gun, can be carried. If the perambulator is to be used for a private carriage, by unscrewing the thumb-screw the sketching-board is removed, and the same board and screw makes a seat for a child: all this can be done without the driver leaving his seat.

CARTS, &c.

Exhibitors.—J. Braby and Son (1345), E. Burnett (1347), F. Campbell (1349), G. Ell and Co. (1365), G. Hazeldine (1378), A. McDougall and Son (1396), T. Milford and Son (1401), F. Parker (1409), J. and W. Rendall (1416), H. C. Simpson (1432), J. Woodbourne (1453).

Messrs. Braby and Son have a spring waggon, the wheels and break of which, on an improved principle, appear to be admirably adapted for the desired ends.

Campbell's sporting cart is light and elegant. Messrs. Ell have some well-made models, and a very useful van. The same may be said of Mr. Hazeldine's, and of the vans shown by Messrs. McDougall and Messrs. Rendall, and Parker's family cart. The carts by Simpson and Woodbourne are remarkably well made, but—as might be expected—although well adapted to the purposes for which they are constructed, there are no peculiar novelties to report.

DISTANCE MEASURER.

In Class VIII. will be found a distance indicator for wheel carriages (1781), which belongs peculiarly to this class. This, "Adcock's Improved Carriage Odometer," is so contrived that it may be readily applied to any form or description of carriage, and easily adjusted so as to adapt itself to any wheel ranging from 2 to 5 feet in diameter. The running wheel communicates its motion to the indicating portion of the instrument within the carriage by means of a column of air confined in an elastic tube. The indications of distance may be read in the dark, that is to say, by the touch if required, there being a small pin or stud projected on the completion of each mile The principles of this "odometer" may be carried out into a variety of forms; it may be placed in any part of the carriage, or held in the hand, without at all interrupting the action of the instrument.

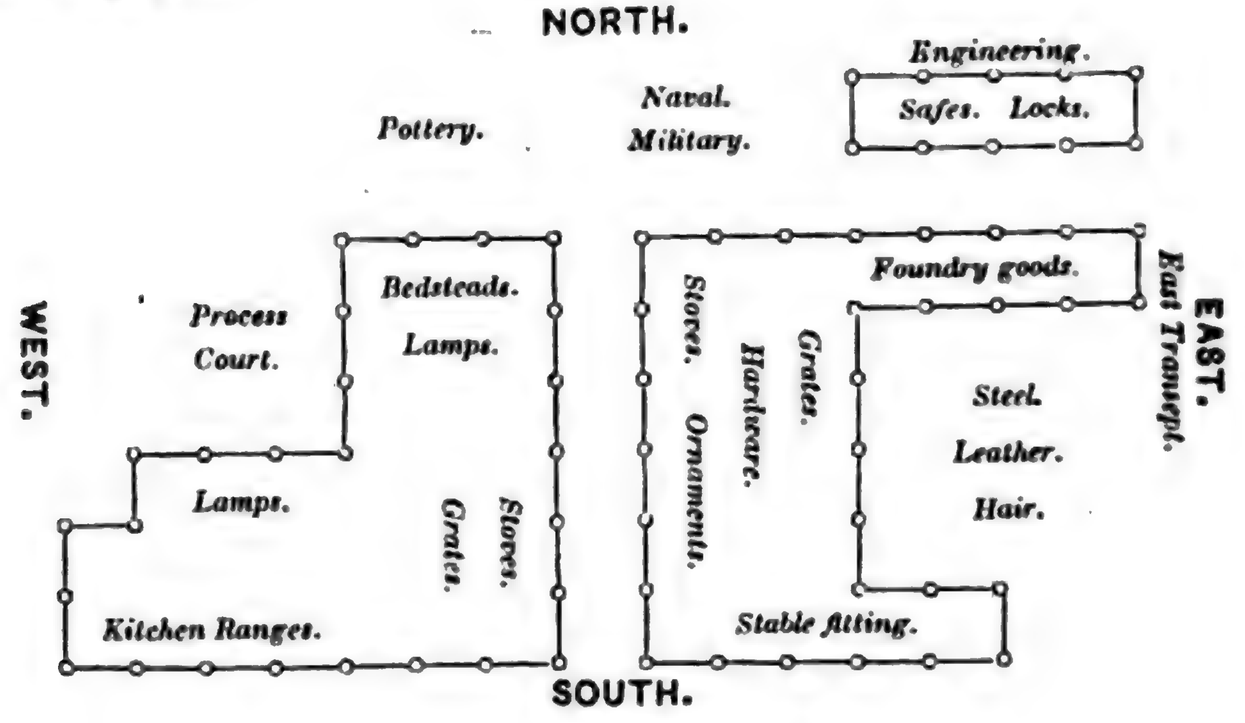
CLASS XXXI.—IRON AND GENERAL HARDWARE.

Number of Exhibitors, 411.

SITUATION OF CLASS.—*The South Court. The principal division of the Court extends from the Eastern Transept, westward, nearly to the Central Avenue, the Classes devoted to* PRECIOUS METALS *and to* POTTERY *bounding it in that direction. From the south inner wall the Court extends northward, and joins the Classes devoted to* CIVIL *and* MILITARY ENGINEERING, *and to* NAVAL ARCHITECTURE.

A few striking objects find their places in the Eastern Transept, and on the eastern side of it are some fine courts devoted to Ecclesiastical Metal work, to Gas apparatus, &c.

Position of Groups.—These are very much mingled in this Class, but the main features of the groups are distinguished on the accompanying plan.



CHURCH FURNITURE.

Exhibitors.—Hart and Son (6307), E. Matthews (6326), J. W. Singer (6344), Skidmore Art Manufactures Co. (6345), T. Thomason and Co. (6352).

The arrangement of these objects is necessarily an unsystematic one, for on account of the great size of many of them it has been necessary to place them in various parts of the Nave and South-eastern Transept.

The Skidmore Art Manufactures Company furnish the most important piece of wrought metal work, in the shape of the new rood screen for Hereford Cathedral, designed by Mr. G. G. Scott, R.A. This work consists of an open arcade of five arches, each of which is divided by a central shaft, and has the head of the arch fitted with geometrical tracery. The central arch is larger than the others, and forms the entrance to the choir. The head is fitted with a vesica-shaped panel and other tracery, and is further surmounted by a crocketed canopy with an ornamental cross on its summit. The other four arches are of smaller size, and are disposed, two on each side of the central entrance; the lower part, up to the top of the bases of the columns, being fitted up with an ornamental grating of quatrefoiled panels, with a tracery of passion-flowers. The whole work is richly coloured; the principal shafts are covered with polished brass-work, and are ringed at mid-height with brass rings studded with balls of polished fluor spar. The side arches are divided by slender twisted shafts of brass. The principal lines of the arch heads, as well as the canopy and finial cross, are enriched with glass mosaics and fluor-spar ornaments. The whole of the iron-work of the framing and the floral tracery fitting the arch heads is coloured in harmonious combinations, of dull red marone, purple, green, vermilion, and white, with a judicious use of gilding in the more intricate portions of the tracery. The figures placed in the central arcade, and on the caps of the dividing columns, are coloured of a bronze-red tint.

A large collection of photographs, including details of this screen, and of a similar one erected in Lichfield Cathedral, as well as views of the ornamental roofing of the new University Museum at Oxford, will be found in the same place.

Messrs. John Hardman and Son occupy the whole of one of the small courts under the Gallery on the eastern side of the South-east Transept. The walls and ceiling of this court are coloured and decorated in a very tasteful manner. The back wall is divided by floreated borders into three divisions; the side ones are covered with scrolls bearing the names of the principal painters, metal-workers, and decorators of Northern Europe and Italy, commencing with Giotto and ending with Quintin Matsys. In the central division are emblazoned the royal arms of England, under which is placed the device of the late Mr. A. W. Pugin, the well-known pioneer of the revival of Gothic art. The side walls are also divided into panels, which are fitted with rubbings from monumental brasses recently executed, among which are the monument to Mr. J. Britton, in Salisbury Cathedral, and those to Bishop Monk and Sir Robert Wilson, in Westminster Abbey. The ceiling is divided into square panels, which are coloured blue and diapered with gold stars. The centre of the court is occupied by a group of "The Virgin and Child Enthroned," sculptured in Staffordshire alabaster, which is intended to be placed in the chapel of Oscott College as a memorial of the late Principal. It is placed upon a pedestal, round which are carved typical figures of holy women from the Old Testament, and in bas-relief on the throne, the Triumph of the Wisdom of the Serpent; the Fall and Punishment of Adam and Eve, &c. The figure of the Madonna is vested in a rich mantle covered with gold fleur-de-lis; on her knee stands our Lord holding the book of divine wisdom.

The gates at the entry of the court form a portion of the Pugin memorial, to be erected in St. Augustine's Church, Ramsgate. They are made entirely of wrought iron in slender rods, worked into geometrical patterns, into which is set a broad band of fleur-de-lis, formed of thin perforated iron plates enriched with roses. A bow or strong curve, in which the inscription "Ave Maria" is repeated in each bay, or six times in all, is placed near the top; above which the main dividing lines are carried up with the finials of lily flowers.

The jewellery and silver plate for domestic, as well as ecclesiastical purposes, containing chalices and patens, ciboria, monstrances, candlesticks, wells, cruets, flagons, alms dishes, inkstands, loving cups, salvers, &c., are among the more noteworthy of the numerous objects in this court.

On the south side are several monumental brasses: one to the Lady Georgiana, Countess of Carlisle, for Welburn Church, Castle Howard; another to Major Armstrong, of the 18th Royal Irish, for St. Patrick's Cathedral, Dublin; and several more. From the ceiling is suspended a number of gas and candle coronas and lamps.

The adjoining court to Messrs. Hardman is occupied by Messrs. Hart and Son, and is decorated in a somewhat similar manner, but with stronger colours. The collection is of an analogous character, the strongest points being in ornamental brass standard, coronæ, lamps for lighting churches, as well as for private use, and smaller works, such as silver, gold, and enamelled plate, all in Gothic making.

Mr. J. W. Singer's collection of mediæval metal work is placed in the front of Messrs. Hart's court.

PILLARS, RAILS, GATES, GARDEN SEATS, STAIRCASES, AND VERANDAHS.

Exhibitors.—W. Baily and Sons (5977), Barnard, Bishop and Barnards (5980), W. Chambers (6014), Cottam and Co. (6025), J. Geddes (6070), P. Rogers and Co. (6204), J. Finch (6061), Longden and Co. (6142), St. Pancras Iron Work Co. (6209), G. B. Cooper (6022).

Mr. Thomas Potter's gates, placed in the corridor under the Gallery, at the back of Class X., are made of wrought iron, painted of a rich reddish-brown colour, and are further ornamented with stag's heads, pheasants, and other game birds, in gilt gun-metal.

A large group of gates for a park entrance, by Messrs. Barnard, Bishop and Barnards, are placed in the Nave, near the Porcelain and Glass Courts. The piers are formed of cast iron, having small twisted shafts at the angles. The gates are made of wrought-iron bars, largely ornamented with wreaths of oak, ivy, roses, and other common English wild flowers, which have been carefully executed in wrought iron from natural models. In order to render such very delicate work capable of withstanding the destructive effects of the weather when exposed to the open air, the whole of the ornamental parts has been galvanized or coated with metallic zinc before painting.

The following description of these gates appears also in my *Synopsis* :—

The Norwich Gates consist of a pair of centre and two side gates, supported on four substantial iron piers. These have been designed with a view to combine cast and wrought iron in such a way that the more massive parts, having weight to carry, should be of cast metal, and the lighter framing, with all the ornamental work, forged. In accordance with this idea, the piers and the girders over the gateways are of cast iron; the gates themselves, the scroll-work over them, and the panels and mouldings of the piers and girders, are of wrought iron. The only enrichments attempted in the castings are slightly raised patterns in places, and the solid heraldic animals on the piers. The gates are framed of square bars, and filled with devices copied from nature, composed of the vine, hawthorn, ivy, and wild rose. The principal piers are about eighteen feet high, the pedestals of these are three feet square, the shafts in proportion, above which are capitals enriched with foliage in wrought iron, the whole being surmounted by griffins supporting shields. In the shafts are introduced panels of wrought iron, in which the stem and foliage of the oak form a groundwork, which is interlaced by convolvulus, bryony, smilax, periwinkle, ivy, &c. The external piers are of a similar character, but reduced in height. The scroll-work over the central gates is a combination of oak and olive branches, with the old double rose. These surround a shield bearing the arms of Norwich, over which is a knight's helmet. The scrolls over the side gates are composed of branches and flowers of the hawthorn. The whole has been designed and superintended by Mr. Thomas Jekyll. These gates are a fine example of the blacksmith's craft. They are made entirely by the hand, with hammer and pincers, as they would have been done five hundred years ago, and are not, as might be supposed, done on the same principle as the stamped brass goods.

The Colebrookdale Company have filled a large portion of the South-eastern Transept with their works, which include a considerable variety of ornamental work in cast-iron. The principal objects are a large pair of park gates, executed for H. R. H., the Prince of Wales, in bronze, and having the dividing pillars coloured with dark-blue enamel, and covered with an open lattice casing, also bronzed.

Other examples of park gates in wrought iron are exhibited by Messrs. W. Baily and Co., and Messrs. M. Feetham and Co.

The gates of Messrs. Hardman and Co. have been already named.

Another large pair of park gates, by Messrs. Kennard and Co., are placed in the same court; they are intended for the palace of Vista Alta, the seat of Don José de Salamanca, and are remarkable for the skilful manner in which they are coloured; white being employed for flat surfaces, blue on the angles, and red on the edges of the bars, at right angles to the plane of the gates; while all the higher projecting portions of the ornamental scroll-work and foliage are gilded.

GRATES AND STOVES.

Exhibitors.—**W. Addis (5971), Benham and Sons (5986), W. Bennett (5987), Collin and Green (6020), F. Edwards and Son (6048), J. Evans and Co. (6056), J. Finlay (6062), General Iron Foundry Co. (6071), J. Gray and Son (6081), H. E. Hoole (6108), C. Jeakes and Co. (6119), J. Leighton (6135), W. Lewis (6137), Longden and Co. (6142), Mapplebeck and Lowe (6148), H. Crichley (6028), J. Mills (6154), J. Morton and Sons (6158), Musgraves Brothers (6159), S. Nash (6161), J. Nettleton (6164), W. N. Nicholson (6168), Redmayne and Co. (6190), Ritchie (6198), Rickets and Hammond (6196), W. Roberts (6200), Robertson and Carr (6201), J. E. Ryffel (6208), Smith and Wellstood (6215), J. M. Stanley and Co. (6219), J. C. Stark (6220), Steel and Garland (6221), Stuart and Smith (6223), J. Taylor, jun. (6227), W. Pierce (6180) T. Walker and Son (6239), J. Billing (5989), J. Brown and Co. (6000), Carron Co. (6012.), W. Young (6268), T. F. Jones and Sons (6125).**

The Sheffield Court, which may be regarded as embracing both steel and ordinary hardware, being placed at some distance from the Nave, does not receive the number of visitors which frequent more favoured and attractive localities. Its productions, however, are not the less interesting and important, and fully keep pace with the manufacturing interests of the kingdom. The steel products are well represented by Naylor, Vickers and Co., Bessemer, and others, in the Southeastern Nave. The beautiful cutlery of Rodgers, Wostenholm, Mappin, Hargraves, &c., will long support the fame and trade of the town; notwithstanding the rapid strides of the French manufacturers in this branch of enterprise.

The large assortment of stove grates will gratify the taste of the visitor, and will repay the search for this department of our manufacturing industry.

The substantial, ornamental, and artistic grates and fenders exhibited by Hoole are, as in 1851 and 1855, the best of the kind in the Exhibition, and being designed and modelled by English artists, chiefly in connection with our Schools of Design, reflect much credit upon Mr. Hoole's spirited enterprise and skill. The boudoir stove, in blue and gold, the ornamental air stove in real bronze, the pillar grates, and the designs in porcelain, occupy a prominent place amongst the interesting objects of this Court. These are followed by the productions of Stuart and Smith, Yates and Co., Wright, Redmayne, and others; but we leave the further description of these necessary and useful articles of our domestic economy to those whose taste and interests lead them to visit the Hardware Department of the Exhibition, the more important of which must have their especial notices.

The exhibition of fire-grates is very large and perfect, most of the principal English manufacturers being represented. It would be scarcely possible to give an idea of the nature of these beautiful objects without describing each individual example; suffice it to say, that nearly every class of ornamental manufacture is laid under contribution for their decoration, giving a series of graduated effects from those which shine, to impress us by the beauty of the plain, black castings, up to the most startling combinations of bright steel and gold, with encaustic tile mosaics, majolica, or painted porcelain. We may specially point out, as the greatest novelty in this class of work, a fireplace by Mr. H. Hoole, in which the chimneypiece is formed of open-worked golden panels upon a groundwork of deep blue enamel, the ornament being in the style of the later Renaissance period.

In addition to their attraction as ornamental objects, a few patterns of stoves are exhibited involving novelties in construction, and may therefore be considered as coming more into the legitimate province of the Industrial *Handbook*: some of these are briefly noticed in the succeeding paragraphs, others have already been referred to as exhibited in Class X.

Mr. Thomas Walker's grate is constructed with movable cheeks or joints; lined with slabs of fire-brick to allow of the fireplace being expanded or contracted.

In Mr. John Billing's grate, exhibited by Messrs. Benham and Sons, the smoke from the fire is made to pass in close contact with the ignited fuel, behind the fire-brick back of the stove, through two side flues; by which means it is more effectually consumed, and the direct effects of a draught of wind down the chimney are avoided. The adjustment of the front draught up an ordinary chimney allows the stove to be adapted for consuming different kinds of fuel with advantage. The space included between the chimney opening and the fireplace is arranged so as to form chambers, which can be used for heating air for use in adjoining rooms.

In Mr. John Taylor's stove the smoke is consumed by being made to pass by means of a side flue, through the burning fuel, before escaping up the chimney; the sides of the grate are formed of tubular fire-brick slabs, which are intended to be used for heating air which is afterwards introduced into the apartment through a series of perforations in the ornamental hood casing of the fireplace. The action of this contrivance is fully illustrated by several examples, a collection of sectional drawings, and a large ornamental diagram.

Musgrave's slow-combustion stove consists essentially of an upright cylinder of fire-clay, sufficiently capacious to hold a supply of fuel for 24 hours' consumption. The top opens to the flue, and there is a small grating in the bottom that slides loosely in a frame, having a handle which is reached from the front of the ash box; the fuel is fed through an opening in the top, covered by a plain sliding door; the air is admitted through a very small opening obtained by sliding the ash-pit door to one side; the ashes are removed by lifting the door, which cannot be left open, but immediately falls back to its place when the ash-pit has been cleansed.

The smoke and heated gases from the fire are passed through two labyrinthine chambers, or secondary stoves, the walls of which abstract the heat from the current on its way to the chimney. This heat is subsequently imparted to the room by means of a current of air circulating about the outer side of the chambers. The same principle is applicable to cooking stoves, and is effected by covering in the front of the fire with sliding plates, an arrangement which gives the advantages of the closed stove and open-fireplace in one apparatus.

Messrs. Ritchie and Co. exhibit iron mantlepieces. These are almost a new feature, and can be recommended for their excessive cheapness and taste. They can be easily fixed, as they do not require stone jambs.

Messrs. Edwards and Son have introduced with great effect porcelain tiles into their grates. Porcelain has been used for many years in the construction of grates, but chiefly for the wealthy. It is now shown it can be used with economy. It is susceptible of the most beautiful treatment; and there is no trouble given to servants in cleaning.

Fire-brick is a most serviceable material in the construction of grates, and it has been introduced into all those exhibited by this firm, who have also made two very inexpensive grates, formed entirely of fire-brick, with the exception of the bars, for use in bedrooms, and for the poorer classes.

Messrs. Edwards also exhibit a handsome pedestal stove, formed of metal, with terra-cotta tubes in the inside, for the passage of warm air into the room.

Mr. John Leighton is also an exhibitor of a smokeless stove.

There are only three principal ways of coaling a fire, namely, the old way of coking the coal at top, which allows the gas and bituminous smoke to escape; the Cutler, Arnott, and Jeakes' mode of coaling at the bottom; and Mr. Leighton's plan of supplying at the back and sides, as I propose, retaining the grating at bottom, according to old usage (for this is a valuable means of cheering the fire); and when the fire is made up, there is no difference perceptible from the ordinary smoking fire, except in the fire itself, which is uniformly good, and will keep in.

In the South-eastern Transept, close to the steel collection of Naylor, Vickers and Co., is placed the metropolitan Hardware trophy; this consists of a collection of fire-grates, door-plates, knockers, and other ornamental works in cast and wrought iron and brass, arranged on the four sides of a quadrangular framework, which is terminated by a skeleton roof with an ornamental ridge cresting. The exhibitors are—1. Messrs. Benham and Co., who exhibit iron-work, and plate after the early Gothic models of the 12th century; 2. Messrs. Hart and Son., whose metal work is of a later and more ornamental Gothic type; 3. Messrs. Feetham and Co., who send a number of fire-grates in Renaissance style, the finest being an Elizabethan example, and two steel panels with etchings of Tubal Cain and Prometheus, the "Fathers of Metallurgy;" and 4. Messrs. W. Baily and Son, who also exhibit Elizabethan and later Renaissance works.

C. Jeakes and Co.'s patent smokeless and sustaining fire-grate will burn from twenty-four to thirty-six hours without replenishing, and without smoke or waste. A 15-inch fire consumes less than 1 lb. of fuel per hour. In this grate the most ordinary and cheapest coal may be burnt with advantage. This is effected by placing the supply of fuel in a chamber behind. The fire is ignited on the surface, and the coal supplied from below, so that the carbonaceous matter distilled from the new coals, passing through the incandescent mass above, is burnt, consequently no visible smoke escapes.

The so-called "gill calorifiers" are exhibited in variously-modified forms by many exhibitors; this arrangement consists of a closed fire-place having a number of projecting flat plates, or gills, placed edgewise on its outer surface. The narrow, intermediate spaces between these plates form chambers in which the air is heated, and is afterwards distributed through the room by means of the current thus set up. In the calorifier exhibited by Messrs. J. M. Stanley and Co. the air passages are of a tubular form.

Mr. W. Young's plan for smoke-consuming is very ingenious; it consists in introducing the fresh fuel from below, so as to allow the products of the distillation of the coal to pass through the ignited column above them, where they are perfectly consumed. This is effected by placing the coal in an iron tray in front of the grate, in which is placed a right and left-handed screw worm. When the fire is to be fed, the screw is turned by a ratchet and lever, which raises the burning embers and deposits the fresh fuel in their place.

KITCHEN RANGES AND COOKING APPARATUS.

Exhibitors.—**W. S. Adams and Son (5969), W. Addis (5971), J. Allan, sen. (5972), W. N. Backhouse (5976), Brown Brothers (6001), Brown and Green (6002), E. Deane (6032), Duley and Sons (6042), W. Easthope (6044), F. Edwards and Son (6048), E. J. Elliott (6050), J. Evans and Co. (6056), S. Flavel and Co. (6065), Goddard (6078), J. Gray and Son (6081), Hayward Brothers (6098), R. Hewens (6101), C. Jeakes and Co. (6119), Jones and Rowe (6124), Mapplebeck and Lowe (6148), A. May (6152), J. Mills (6154), S. Nash (6161), W. N. Nicholson (6168), Nock and Price (6169), W. Owen (6173), T. Phillips (6178), T. Radclyffe (6188), Ritchie and Watson (6199), W. Roberts (6200), J. Sherwin (6211), Smith and Wellstood (6215), J. M. Stanley and Co. (6219), C. and S. Talbot (6225), Winchester, Graveley, and Sager (6256), Benham and Sons (5986), J. C. Ashwell (5974), Carron Co. (6012), R. Nicholas (6167).**

Kitchen stoves and cooking-ranges are largely represented in every variety, from the "Economic Cottage Range," 2 feet wide, up to the most elaborate apparatus suitable for clubs, hospitals, and other public institutions. In most cases the object of the maker is to reduce the area of the open fire as much as possible, by enclosing it with iron plates on the top and front, the heated gases being made to pass through a series of horizontal flues over a graduated system of ovens, which are usually distinguished as roasters, pastry ovens, and stewing or hot closets, according to their distance from the source of heat. In the larger ranges, large wrought-iron boilers are occasionally added for the purpose of supplying hot-water or steam to different parts of the house. An example of a range with a large open roasting fire, is exhibited by Messrs. Benham and Co. This range, which is intended to cook for from five to seven hundred persons, is remarkable on account of the very small fire. It consumes only two hundred pounds of coal per day. It has an ingenious contrivance for boiling or steaming. A large reservoir is kept full of boiling water, and from this steam or hot water can be drawn as required.

A small number of gas-cooking stoves are also exhibited; they are mostly of very simple construction, the open fires being formed by burning the gas off a jet formed of a spiral tube pierced with a number of very fine holes; the ovens are heated by a similar kind of jet forming three sides of a rectangular figure, which is placed near the floor.

In one example, contributed by Messrs. Rickets and Hammond, the gas-stove is combined with an ordinary coal-burning range.

Smith and Wellstood's "Empress" cooking stove has many improvements, which are thus described by the patentees:—

These stoves are constructed with the four oven doors, having an inside lining of bright reflecting surface sheet metal, with an air space between the linings and the doors, whereby the generated heat is prevented from passing through the metal composing the doors, or from being radiated away from the outside surface. By the adoption of a reflecting surface of metal for the inside linings, the constructors suppose the heat is thrown back, and concentrated upon the centre of the oven.

The top of the stove is also fitted with a light *movable* "concentrating hood" or cover, for enclosing all the cooking utensils which may be in use on the stove, and having not only the same effect as the linings and jackets in preventing the over-heating of the kitchen, but also arresting the circulation of steam through the apartment, and concentrating the heat rising from the top or hot plate of the stove so directly upon the sides of the cooking vessels in use, that a much smaller consumption of fuel is necessary for all the operations required of the stove.

The advantages of many of these arrangements are obvious, and the stove is an excellent one; but the constructors place too much reliance on their "metallic reflectors," forgetting that they have to deal with radiation rather than reflection; and that a surface covered with lamp-black will give a radiating power of 100, whereas polished iron will only give 15.

Bradley's kitchener is exhibited by W. Owen. This is a very fine kitchen range, of polished iron. The flues are so constructed that the smoke and hot air pass round and behind the ovens, giving increased heat with a smaller fire. If a larger fire is required for roasting, the cap over the grate can be taken down, and two iron cheeks drawn out from the back, which form a kind of chimney. The jack for roasting the meat is turned by an ordinary fan in the chimney.

Yates and Co. have two kitchen ranges, one a "Yorkshire range." These have no peculiarity in their construction. The latter has two ovens on one side—one above the other; the hot air and smoke escape between the two, and heats both. Besides these, they have some ornamental fireplaces and grates of very handsome design, particularly one of white marble, with polished bars, &c.

G. Wright and Co. show a very handsome kitchen range. It is intended to cook for from 1,000 to 1,500 persons. It has three fires, one in the centre and one on each side—otherwise nothing new in construction.

The Colebrookdale Company have two kitchen grates of improved construction. One of these is fitted with Young's patent screw for feeding the fire. The coals are thrown on this screw, and by this means placed in the centre of the fire. The smoke escapes through the back. The ovens and boilers are fitted with separate valves for regulating the ventilation. The other, Richards's patent, is semicircular in construction, and has an apparatus for raising the grate, so as to increase and diminish the fire.

Brown Brothers boast of having produced a range "admirably adapted for every requirement in the mansion, villa, hotel, or cottage; they are also constructed so as to offer unequalled advantages to public schools, or for the use of ships. By a fire small in comparison with the work accomplished, these ranges are stated to perform every culinary operation with complete success and surprising economy of fuel, time, and labour. Perfect in themselves, they can scarcely be regarded as household fixtures, for without difficulty they are frequently removed from house to house; they are known to save from 50 to 60 per cent. in fuel, at the same time being certain preventatives of smoky chimneys." It is hoped the manufacturers are not promising too much.

There appears, however, to be no reason for doubting this statement, for the arrangements have been carefully studied. Perhaps the most interesting, because ingenious feature, is the automaton roasting-jack, which by a very simple arrangement supersedes weight, spring, or any of the contrivances usual in bottle, or smoke-jacks. Every one knows that according to the rate of combustion in a fire, so is the velocity of the current passing in; and that anything acting as a "blower" increases the force of the current. This current of air is made available instead of, as heretofore, the smoke, or draught in the chimney.

E. Deane has constructed his ovens of steel, in the range exhibited, which he represents as possessing many advantages.

Brown and Green have some novelties in the arrangement of their range. At the side of the fire is a boiler which projects forward under the hot plate to the front of the range, and forms the side of the fireplace; and *beyond* this boiler is placed one or more spacious ovens. The heat from the top of the fire is carried over the top of the side boiler, between it and the hot plate, and is then passed completely round the ovens before it obtains an outlet into the chimney. From the bottom of the fire another distinct current of heat passes through an arched flue under the same boiler and is carried up on the other side, between it and the first oven, and, uniting with the draft from the top of the fire, is also passed entirely round the ovens before it can escape. Where an apparatus of larger dimensions is required the same arrangement is repeated on the opposite side of the fire; whilst at the back is placed another large boiler, the lower part of which projects forward into the middle of the fire, the under surface forming a half arch which corresponds with the arched flues under the side boilers, thus affording effectual means of heating it without any escape of hot air. The shape and position of the boilers, and direction of the flues, form peculiar and most important features in this invention. The boilers being *surrounded* by the full heat of the fire.

Mapplebeck and Lowe exhibit the "Leamington Cooking-range."

The Leamington Prize Kitchener, and Young's Patent Smoke Consumer is exhibited by T. Radclyffe. By the use of this apparatus the whole of the smoke and inflammable gases produced by the combustion of ordinary coal are not only consumed, but the whole of the heat evolved during their consumption is utilised to the fullest extent. By this patent the coals are introduced at the bottom of the fire, under the ignited embers, so that the whole of the gases given off are burned. The apparatus by which the coals are introduced into the fire consists of an iron tray fixed to the lower portion of the front of the stove. Along this, a right and left hand Archimedean screw is placed. When the fire is to be fed, fresh coals are placed in the tray on the top of the screw, which is then turned by a ratchet-work moved by the poker. By the revolution of the screw, the burning embers are raised up and the fresh coals deposited in the cavity underneath.

Leamington has yet another representative in the way of kitcheners. R. Hewens is the exhibitor of the "Improved Complete" apparatus. There are many convenient arrangements, intended to ensure not only a well-cooked, but a hot dinner, its most important feature being the "regulator," for reducing or increasing the intensity of heat, by lessening the bulk of fire when not wanted for cooking, which is instantaneously effected by shifting the regulator to the extent required to boil a kettle, or heat the surface of the range, or by reversing it, as the case may be; and also for freeing the grate from ash without any waste of fuel.

Amongst other ranges well deserving the attention of visitors, may be named the "Worcester Range" exhibited by Jones and Rowe; and the "Cooking Stove" of Duley and Sons, in which the boilers can be changed with great facility.

Adams and Sons are exhibitors of a cooking apparatus in which many of the best qualities of those already named, are combined.

The General Iron Foundry Company also exhibit a good range. It is difficult, in a collection of kitchen apparatus, where all are good, and where many things are especially ingenious, to particularize; and it must not be supposed that the mention of a few more prominently than others is intended to mark them as having any features of decided superiority.

As accessory to kitchen ranges may be noticed several patterns of roasting-jacks. In addition to the ordinary smoke-jack, we have a project by Longden and Co. for driving spits in large kitchens, by water power. Messrs. Brown Brothers, we have already said, show an ingenious self-acting arrangement by which the indraught air for the fire is made to turn the meat by passing over the blades of a fan.

Mr. E. Deane's roasting apparatus consists of a cylindrical screen containing three parallel sets of rotatory frames which are made to turn both about their own axes and around a central driving shaft, by means of spur wheels.

Mr. G. Zanni's self-acting basting apparatus, is another novel application of mechanics to cooking.

CANDELABRA, LAMPS, WICKS, CHANDELIERS, BRACKETS.

Exhibitors.—W. Aldred (6278), R. Bright (6285), Cartwright and Co. (6286), Chambers and Co. (6287), J. Defries and Sons (6291), J. Fele and Co. (6297), G. Forrest and Son (6298), H. and J. Gardner (6299), W. Harrow and Son (6306), J. Hill (6311), J. Hinks and Son (6313), H. A. Holden (6314), R. H. Hughes (6313), Messenger and Sons (6327), J. Naylor (6329), W. Nunn (6331), F. B. Oerton (6332), G. and J. Oliver (6333), W. Prosser and H. J. Standly (6338), Rennie and Adcock (6341), T. F. Sarson (6343), W. Strode (6349), G. Tillman (6353), J. Warner and Sons (6358), A. Wyatt (6361), J. Evans and Co. (6056), W. Young (6268), R. W. Winfield and Son (6257).

The designs of these articles have been greatly improved within the last few years, and many of those exhibited are fine examples of this. Those by Messenger and Sons may be especially noticed. The perforated metal is a novelty in its application to candelabra and chandeliers. Many of the designs by Mr. Digby Wyatt are of great elegance. The bronze candelabra are of designs chosen with much taste, and finely executed. This firm exhibits chandeliers in which the finest porcelain, beautifully decorated, is introduced with good effect.

Winfield and Son, whose tubes are especially noticed in connection with their bedsteads, exhibit lamps in which they are most effectively introduced. In hiding the weights of the chandeliers which they exhibit, they have certainly effected an improvement. Many of these in electro-plated metal are of graceful form. The smoke-consuming lamps, with terra-cotta covers upon the globes, are said to be very effective in operation, the heated clay continuing the combustion of the carbon. Since the introduction of the paraffin oils various descriptions of lamps have been introduced. In many of them the advantages of the full illuminating power has been gained; but there has been a liability to the escape of vapours which unpleasantly affect those who may chance to be exposed to their influences.

The point to be arrived at in all lamps burning any of these hydro-carbon liquids, is to provide a full supply of oxygen, in sufficient rapidity to ensure the combustion of the least volatile, or heaviest portions of the vaporified oil. It is the escape of these portions which gives rise to smell, and that heavy atmosphere which is sometimes complained of.

In the Fumivore Lamp of Hinks and Son the desired point appears to be arrived at. An experimental trial made with these lamps was most satisfactory. Combustion was most perfect; and by the rapid supply of air, although an intense light was secured, there was but a very moderate elevation of temperature. It is a most important point to secure, in all the lamps intended to burn the mineral oils, that a high illuminating power should be obtained, while the heat produced should be maintained at the lowest possible degree.

In the Fumivore Lamp this desideratum has been nearly obtained. This lamp has no glass chimney, hence the trouble, danger, irritation, and expense, occasioned by the use of glass chimneys, in the ordinary paraffin and other lamps, are entirely removed. A current of air is brought directly upon the vapour, as it escapes from the liquid in the capillary cotton of the lamp; and there is generated a secondary current within the globe, which meets and compels the combustion of all vapour at any part of the flame, thereby removing the cause of the unpleasant odour occasioned by the use of the ordinary paraffin oil lamps. Unlike the ordinary lamps, it is not to be injured by steam or damp, which makes it valuable for railway purposes, ships, cottages, and workshops. These advantages render it a cheap, clean, and good illuminating lamp; and it is susceptible of the most elegant and artistic designs.

It cannot be too often stated, that those who burn paraffin oil should be careful to select specimens which do not give off an inflammable vapour at 100° Fahrenheit. This is readily determined by placing the suspected oil in a spoon floating on hot water, and holding a light above it.

BEDSTEADS.

Exhibitors.—T. Allen (5973), T. Bryon (6004), W. Chambers (6014), R. W. Winfield and Sons (6257), S. Whitfield and Sons (6251), T. Upfill and Sons (6236), Tylor and Pace (6235), J. Finch (6061), Hulse and Haines (6110), Lambert Brothers (6132), Harlow and Co. (6096), Perry and Son (6176), Peyton and Peyton (6177).

Metallic bedsteads of various kinds, from the most common iron one to those of brass-work most elaborately ornamented, are exhibited. Of these, however, but little can be said; there is nothing new in any principle of construction, neither is there anything especially remarkable in design. Harlow and Company show with what facility a couch of iron can be constructed, by exhibiting a bedstead made by machinery in nineteen minutes. Beyond this it appears necessary only to direct attention to the tubes of which the bedsteads made by Winfield and Sons are constructed. The ordinary process of drawing a brass or copper tube is tolerably well known. Rolled metal is cut to the required breadth by means of revolving discs; it is then generally curved by means of a pair of rollers, and in this condition is passed through a steel hole or a die—a plug being so adjusted that the metal passes between it and the hole. The join in the tube is then soldered, and the tube finished by cleaning with acid and passing through a finishing hole plate.

Taper tubes are drawn at an ordinary draw-bench, a ductile metal tool being used through which the soldered case placed upon the mandril is drawn. In this manner are produced reeded, fluted, octagonal, oval, or square tubes. Mr. John Ward, one of the workmen in connection with these works, is the inventor of this process. These tubes are now ornamented by a kind of "Nature Printing," which was introduced many years since by Mr. W. C. Aitkins, for the ornamentation of German silver and other white metal goods. A piece of lace, or any raised woven pattern, a fern or a leaf, is placed between two plates of metal and passed through a pair of rollers. The result is, that the pattern is beautifully imprinted on the surface. Many of the patterns upon the tubes exhibited are very elegant, and they are produced as described, before the formation of the tube.

Peyton and Peyton have some bedsteads of very superior manufacture. There are some other exhibitors, but there are no peculiarities which merit any especial notice.

Brierley and Geering are exhibitors of a four-post iron tubular bedstead, the panels of the rails ornamented by a patent process, to be described under "ENAMELS," in which iron is coated with paper and protected by a coating of hard enamel.

DRINKING-FOUNTAINS.

Exhibitors.—W. Hood (6107), Wills Brothers (6255).

Adjoining Mr. Potter's gates are placed a series of drinking-fountains, executed in cast iron, by the Colebrookdale Company, from the designs of Messrs. Wills Brothers. This Company has also a design for a fountain, having a central figure of Oliver Cromwell, with two recumbent figures, representing Peace and War, on a lower pediment, after the model of the tomb of the Medicis by Michael Angelo. Some specimens of castings from ferns and orchidaceous flowers are exhibited in the rough state in which they were taken from the moulds, in order to show the perfect nature of the work.

The drinking-fountains exhibited by Mr. Hood are distinguished by the nice style of ornamentation and general character of the designs. Their specimen castings merit an attentive examination.

TANKS AND CISTERNS.

Exhibitors.—Burney and Bellamy (6008), J. Cormell (6023), C. Davies (6029).

The iron tanks of the first of these exhibitors are well known in the trade. They possess no peculiarity requiring any special notice. Cormell's coated cisterns and cattle troughs are well made, and Davies's examples, manufactured in galvanized iron, are of a very useful description.

COACH, HARNESS, AND HORSE FURNITURE.

Exhibitors.—S. Cox (6027), T. Gibson (6074), J. Hale (6089), J. Hawkins and Co. (6097), Hill and Smith (6103), H. Maxwell and Co. (6151), W. Standley (6218), T. Upfill and Sons (6236), T. Newton (6666).

Much of the stamped metal-work exhibited is characterized by the display of considerable taste. The collection shown by S. Cox, and that by T. Newton, although they do not require any special notice, are each excellent in their way.

Springs and axletrees exhibited by Gibson are of a very fine quality, and of beautiful finish. They are also exhibited by Hill and Smith, and Upfill and Sons.

Spring hooks, curb-chains, and bits, exceedingly well made, are exhibited by J. Hale. Stirrups and spurs by Hawkins and Co. Maxwell and Co. display a fine collection of the latter. W. Standley's collection of these articles is a good one.

SUNDRY MANUFACTURES IN TIN, LEAD, AND ZINC.

Exhibitors.—B. Azulay (6373), F. Braby and Co. (6375), J. Chatterton (6376), H. R. Cooksey (6377), J. Dixon and Sons (6378), J. Ellis (6379), Henrietta Ewart (6380), S. Foxall (6381), J. A. Gilbert and Co. (6382), Hickman and Clive (6383), Watts and Harton (6390), R. W. Wilson (6391), J. Zobel (6393).

The collection of "galvanized" metals—most incorrectly so called—which is exhibited by F. Braby and Co., are well deserving attention. The perforated zinc prepared by this firm show much variety in design, at the same time that the perforations are so placed that the strength of the metal is not in any way interfered with. Strength, lightness, and, in many of the examples, elegance are secured.

The lead, tin, and composition pipes, by Mr. Chatterton, are of an excellent character. Lamal and Co. are also exhibitors of good pipes. Dixon and Sons are exhibitors of Britannia metal goods, which are good examples of this class of manufacture. Several alloys possessing nearly the same general character pass under different names. The composition of a few of these is as follows:—

	Copper.	Zinc.	Tin.	Nickel.	Antimony.
Britannia Metal – –	1·000	2·00	81·00	–	16·00
English Nickel Silver	60·000	17·8	–	22·2	–
Parisian Ditto – –	50·000	13·6	–	19·3	–
German Silver – –	50·000	25·0	–	25·0	–

The japanned zinc goods of H. Ewart are of a superior character; and several other things might be named, but there is not anything standing out beyond others requiring especial description.

HINGES, BOLTS, LOCKS, AND KEYS.

Exhibitors.—R. C. Adcock (5970), W. C. Bamber (5978), G. Berry (5988), J. Billinge (5990), F. W. Blackett (5993), J. H. Boobbyer (5996), Bracker and Gripper (5998), Bramah and Co. (5998), Carpenter and Tildesley (6010), Chatwood and Daws (6015), Chubb and Son (6017), E. Cottrill (6026), J. Gibbons (6072), Emilia Gollop (6079), Hamilton and Co. (6092), G. Harley (6095), Hobbs, Ashley and Co. (6105), R. McConnel (6144), F. C. Martineau (6149), Nettlefold and Chamberlain (6163), G. Phillips (6179), G. Price and Co. (6186), W. Bissell (5992), T. White (6249), H. Yates and Sons (6266), Elliot's Patent Sheathing and Metal Co. (6052), Gibbons and White (6073), J. Whitley (6252), Watkins and Keene (6243), Tucker and Reeves (6233), E. Edwards (6047), Hayward Brothers (6098).

SAFES, CHESTS, AND STRONG DOORS.

Exhibitors.—Chubb and Son (6017), Dyke and Co. (6043), Hamilton and Co. (6092), J. Leadbeater and Co. (6134). C. Price and Co. (6185), H. Richard (6194), J. Spokes (6216), S. Whitfield and Sons (6250), G. Price (6186), W. Rhoder (6193), Tucker and Reeves (6233), G. Withers and Sons (6259), J. Tann (6226).

These articles are found to be so closely associated, that it is almost impossible to consider them apart.

George Price's treble patent safes and locks have been tested and approved. Mr. E. B. Denison has made a report on these locks, from which the following remarks are taken. They apply equally to the lock and the safe.

"1. It seems to me equally secure with Hobbs's 'Protector,' or movable stump lock, against that mode of picking by which it is well known that other locks of the highest reputation can be opened in a few minutes by any man of ordinary mechanical skill. 2. It would be impossible to blow it open with gunpowder, on account of the unusual smallness of the space into which any powder could be rammed. 3. Neither is there room to get in any instrument strong enough to force the lock open or cut away the tumblers. 4. The impossibility of shutting the safe door with the handle *without using the key*, will certainly prevent people from forgetting to lock the safe when they shut it. 5. It is an incidental advantage of this lock, that if any of the tumblers get stuck together, and so one or more of them rise too high, they can be brought down again by the key or any proper instrument. 6. The position of the keyhole and the stump is such that any variation in the steps of the key makes more difference than usual in the lift at the stump; and consequently it would be harder to copy accurately enough for a false key. 7. I am glad you have adopted a solid key, as it gives a smaller key for the same strength, and leaves no pipe to get plugged up with dust. 8. As to the safe itself, apart from the lock, I have long been convinced that no safe *is* safe unless the whole of the exposed surface is harder than any drill. The plan of case-hardening the whole surface of a wrought-iron safe is the simplest and best that I have heard of. 9. I do not understand how anybody can expect the things in a safe not to be burnt in a fire, if it is made without the proper chemical composition for resisting fire."

This composition has been applied to the safes.

Bramah and Company are exhibitors of their excellent safes and locks. The latter are so well described by Mr. Tomlinson, that I hesitate not in adopting his description.

"The body of a Bramah lock may be considered as formed of two concentric brass barrels, the outer one fixed, and the inner rotating within it. The inner barrel has a projecting stud, which, while the barrel is rotating, comes in contact with the bolt in such a way as to shoot or lock it; and thus the stud serves the same purpose as the bit of an ordinary key, rendering the construction of a bit to the Bramah key unnecessary. If the barrel can be made to rotate to the right or left, the bolt can be locked or unlocked, and the problem is, therefore, how to insure the rotation of the barrel. The key, which has a pipe or hollow shaft, is inserted in the keyhole upon the pin, and is then turned round; but there must be a nice adjustment of the mechanism of the barrel before this turning round of the key and the barrel can be insured. The barrel has an external groove at right angles to the axis, penetrating to a certain depth; and it has also several internal longitudinal grooves from end to end. In these internal grooves thin pieces of steel are able to slide, in a direction parallel with the axis of the barrel. A thin plate of steel, called the locking-plate, is screwed in two portions to the outer barrel, concentric with the inner barrel, and at the same time occupying the external circular groove of the inner barrel: this plate has notches, fitted in number and size to receive the edges of the slides which work in the internal longitudinal grooves of the barrel. If this were all, the barrel could not revolve, because the slides are catching in the grooves of the locking-plate; but each slide has also a groove, corresponding in depth to the extent of this entanglement; and if this groove be brought to the plane of the locking-plate, the barrel can be turned, so far as respects the individual slide. All the slides must, however, be so adjusted, that their grooves shall come to the same plane; but, as the notch is cut at different points in the lengths of the several slides, the slides have to be pushed in to different distances in the barrel, in order that this juxtaposition of notches may be insured. This is effected by the key, which has notches or clefts at the end of the pipe equal in number to the slides, and made to fit the ends of the slides when the key is inserted: the key presses each slide, and pushes it so far as the depth of each cleft will permit; and all these depths are such that all the slides are pushed to the exact position where their notches all lie in the same plane; this is the plane of the locking-plate, and the barrel can be then turned."

Hobbs, Ashley, and Co. are exhibitors of locks and fastenings. Their *protector lock*, which is a modification of the ordinary six-tumbler lock; and also their improved lock, which has for its object the absolute closing of the keyhole during the process of locking. The key does not work or turn on its own centre, but occupies a small cell or chamber in a revolving cylinder, which is turned by a fixed handle. The bit of the movable key is entirely separable from the shaft or stem into which it is screwed, and may be detached by turning round a small milled-headed thumb-screw. The key is placed in the keyhole in the usual way, but it cannot turn; its circular movement round the stem as an axis is prevented by the internal mechanism of the lock; it is left in the keyhole, and the stem is detached from it by unscrewing. By turning the handle, the key-bit, which is left in the chamber of the cylinder, is brought into contact with the works of the lock, so as to shoot and withdraw the bolt. This revolution may take place whether the bit of the movable key occupy its little cell in the plate or not; only with this difference—that if the bit be *not* in the lock, the plate revolves without acting upon any of the tumblers; but if the bit be in its place, it raises the tumblers in the proper way for shooting or withdrawing the bolt. It will be understood that there is only one keyhole, namely, that through which the divisible key is inserted; the other handle or fixed key working through a hole in the cover of the lock only just large enough to receive it, and not being removable from the lock. As soon as the plate turns round so far as to enable the key-bit to act upon the tumblers, the keyhole becomes entirely closed by the plate itself, so that the actual locking is effected at the very time when all access to the interior through the keyhole is cut off. When the bolt has been shot, the plate comes round to its original position, it uncovers the keyhole, and exhibits the key-bit occupying the little cell into which it had been dropped; the stem is then to be screwed into the bit, and the latter withdrawn. It is one consequence of this arrangement, that the key has to be screwed and unscrewed when used; but through this arrangement the keyhole becomes a sealed book to one who has not the right key. Nothing can be moved, provided the bit and stem of the key be both left in; but by leaving in the lock the former without the latter, the plate can rotate, the tumblers can be lifted, and the bolt can be shot.

Attention may also be directed to the *gunpowder and burglar-proof locks*, exhibited by Withers and Son.

The *double-action detector-locks* and safes of C. Price and Co. appear to be of excellent construction, and those by G. Price, of the Cleveland Works, as well as the collection of Mr. W. Greenway, display careful manufacture and great ingenuity in construction.

Chubb's patent detector locks of various sizes, and for all purposes to which locks can be applied, are exhibited. Among them the following are of most particular interest:—1. A large door lock, in walnut-wood stock or casing, the inside front covered with a foliated design, perforated in a single plate of steel, hardened and burnished. The key is wrought in corresponding style. 2. A larger door lock, the case being of polished steel, covered with a very elaborately-finished medieval design, in ormolu open work, and the key designed in corresponding style. 3. A wheel lock, for doors of strong-rooms and safes, throwing any requisite number of bolts all round the door by a single turn of the handle, the whole being secured by four gunpowder-proof locks, each with distinct key. 4. A suite of twelve mortise locks, for room doors, so constructed that each lock has its separate and distinct suite key, opening only that lock.

Chubb's patent fire-proof safes are of various dimensions, among which are the following in particular:—1. A jewel safe, with ornamental sides and door. On each side is a panel of Italian design. The door is executed in similar style, but in a mixture of dead and burnished steel, inlaid gilt scrolls, and ormolu mountings. The interior is fitted up in fancy wood for the reception of jewellery. The door secured by Chubb's patent wheel lock, throwing bolts all round. A very large banker's safe, weighing about four tons, the interior fitted up with drawers, cupboards, and partitions for books. The outer folding-doors, made of wrought-iron plates and hardened steel, combined in the most effective manner into a solid mass or plate, 1¼ inches thick. The doors secured by wheel locks, throwing thirty-one bolts all round, a gunpowder-proof lock on each door, and the main keyholes covered with case-hardened iron scutcheon locks, opened by a gold key so small as to be set in a finger-ring.

If an attempt was made to describe all the varieties of safes introduced, a small volume would be filled. Many are in the highest degree ingenious; but whether the ingenuity has been directed to secure simplicity of action, at the same time that safety is insured, is somewhat doubtful. In all cases fireproof safes consist of two cases, one between the other, the opening between the two being filled in with some non-conducting material, so that the inner lining of the case may never become incandescent. This is in some instances effected by the interposition of clays, in others of chemical compounds, and in some a stream of water is made to flow through the chambers of the case whenever it is exposed to the action of fire.

TINNED, ENAMELLED, AND JAPAN WARE, INLAID AND GILT ORNAMENTS,

Exhibitors.—**Brierley and Geering (5999), Griffiths and Browett (6085), S. Tonks (6231), Patent Enamel Co. (6175), Biddell and Co. (6281), E. Emily Biddle (6282), J. Hind (6312), E. P. North (6330), H. Loveridge and Co. (6385), J. Marston (6386), E. Perry (6387).**

In connection with other examples of the hardware class will also be found numerous kinds of tinware. It is sufficiently well understood that tin-plate is carefully manufactured sheet-iron, covered with a coating of tin by a process of immersion in the melted metal. Plannished tin-plate, being beaten with highly-polished steel hammers, has a bright surface given to it, and of this kind the superior articles are always made. *Japanning* of tin-ware, or any other metal, consists in covering it with a varnish. The best varieties are treated in the following manner:—The article to be japanned is first brushed over with two or three coats of *seed-lac* varnish to form *the priming.* A varnish of the required colour is then laid on for the ground, and on this the design is painted. After which the whole is covered with transparent varnish, dried, and polished. Japanning must be carried on in warm apartments, and the metal is made hot before the varnish is applied, and it is dried in ovens prepared for the purpose. In some cases ordinary painting with lead colours is substituted for japanning. For painting figures in japan work *shell-lac* is usually employed; but sometimes, where the colours are delicate, mastic and fine copal are employed. It should be understood, that japanning consists in covering metal with a resinous varnish, which is coloured according to the taste of the manufacturer.

Brierley and Geering exhibit paper enamels upon iron, by which they secure very beautiful designs, at a comparatively small cost. A beautiful photograph, a fine specimen of chromo-lithography, a drawing, or any design impressed on paper, may be taken; this is fastened by cement to the surface of the iron, which is then heated to a point below that at which paper will char, and at this temperature it is carefully covered with an enamel hard varnish. This, being properly prepared, becomes excessively hard when cold; it is but little liable to injury, and is employed by the patentees in the manufacture of coal-scuttles, finger-plates, and all kinds of goods which are comprehended under the term of lacquered goods.

Papier maché is exhibited by some of the above: this will be more properly considered under Furniture.

ENAMELLED IRON.—Enamelling iron is almost a new art. The articles of cast iron are prepared for enamelling by heating them to a low red heat in a furnace, with sand placed between them; after which they are cooled slowly for the purpose of annealing them. They are next scoured with sand and warm dilute sulphuric acid. The enamel is prepared of broken flint glass, borax, red lead, and oxide of tin: these substances being melted together with some care, and then plunged into cold water. By this means the mass is rendered very brittle and it is easily powdered; in this state it is called *frit*. One part of this is mixed with calcined bone dust and reduced to an impalpable powder. This powder is mixed with water to the consistence of cream, and then applied to the iron previously warmed, which after standing, to remove superfluous moisture, is first heated to 180° Fahr., and then subjected in a proper oven to a vitrifying temperature.

After this first vitrification and subsequent cooling, a second coat is applied, consisting of calcined bones, china clay, and felspar, with a small quantity of potash. This mixture being formed into *frit*—as in the first instance—is ground together with flint glass and calcined flint. In a creamy state this is applied over the first coat, and again subject to a vitrifying heat. Yet a third coating has to be applied: this consists of felspar, sand, carbonate of potash, borax, oxide of tin, arsenic, and fine chalk. This is laid on the iron as before, and subjected to a much higher temperature, so that the second and third coats are fused together. A porcelain-like enamel is thus produced, which is coloured by the employment of the same metallic oxides as are named under porcelain painting.

The Patent Glass Enamel Company are exhibitors of a considerable variety of articles of this description. Other highly useful articles, which the company have produced, are enamelled street tablets; also tablets for indicating the position of the fire plugs, and for railway stations, as well as name plates for counting-houses, warehouses, waggons, &c. These plates are formed of wrought iron, glazed with the patent enamel, the natural colour of the metal showing a rich dark ground through the siliceous coating, and thus forming a deep and effective contrast to the bold block letters, which are of a pure white enamel. A highly important advantage attending these plates, is the conspicuousness of the letters at night; the highly polished surface of the letters reflects sufficient light to make the inscription distinctly visible. But, in the ordinary plates where black letters are put on a white ground, the reverse is the case, for the ground then reflects light, whilst the inscription absorbs it, and is thus rendered illegible. The enamelled plates are moreover unaffected by rain or frosty weather; the glass coating may indeed be said to be indestructible.

The engraved, inlaid, and gilt ornamental work exhibited scarcely requires any special description. It is of all the various kinds which are usually comprehended under the general term of Birmingham ware. The designs are in many cases exceedingly good; in others there is a tendency to drop into the quaintness of a barbarous age, which is not to be commended.

It is curious to note how man advances in his perception of the beautiful in one direction by the study of nature's most graceful forms, and at the same time moves backwards in another direction under the influence of a cheerless superstition which sees no good in anything which is not hardened to the severest asceticism.

ICE-MAKING MACHINES.

Exhibitors.—**W. Fuller (6068), J. Spokes (6216), Wenham Lake Ice Co. (6246).**

The Wenham Lake Ice Company have exhibited their arrangements for preserving ice. The circumstance of the trade in ice is not a little remarkable from its novelty and the extent to which it is now carried on; this natural product being sent to almost every part of the world.

There are some facts connected with the physical conditions of frozen water which are most remarkable. When perfectly still water freezes, the ice is always full of air-bubbles: this arises from the circumstance that water in freezing rejects everything which it may hold in solution,—air—colouring-matter—saline substances—or acids; and being at rest these matters become involved with the frozen particles. But if the water while freezing is slightly agitated, all these matters accumulate either in the centre of the mass, or, as in the case of air, escape, leaving the ice perfectly pure. The ice of the Wenham Lake is in this condition—the water produced by thawing it, not even containing air. It might be incidentally mentioned here, that the water thus obtained free from air does not obey the same law as ordinary water in relation to heat. Ordinary water, at the mean temperature and pressure of the atmosphere, boils at 212° Fahr. But that which is deprived of air may be heated considerably above that point, without indicating the least sign of ebullition; and when it eventually commences, it is rather with the violence of an explosion than as ordinary boiling.

In constructing *ice-safes*, the points to be attended to are—the formation of an envelope, or series of envelopes, which are very imperfect conductors of heat, so that the interior ice may not be effected by the temperature of the external air. Ice wrapped in flannel, for example, continues for a long time, even in a warm room, without thawing—the heat passes so slowly through that material. In all ice-making machines, except such as have been described in Class VIII., freezing mixtures are required; these are such as the following—

Nitrate of ammonia	– 1 part	From + 50° to + 4°
Water – – –	– 1	
Muriate of ammonia	– 5 parts	From + 50° to + 10°
Nitrate of potash –	– 5	
Water – – –	–16	
Muriate of ammonia	– 5 parts	From + 50° to + 4°
Nitrate of potash –	– 5	
Sulphate of soda –	– 8	
Water – – –	–16	

or—

Snow - - - - 3 parts Dilute sulphuric acid - 2	From + 32° to − 23°	55
Snow - - - - 8 parts Muriatic acid - - 5	From + 32° to − 27°	59
Snow - - - - 7 parts Dilute nitric acid - - 4	From + 32° to − 30°	62
Snow - - - - 4 parts Muriate of lime - - 5	From + 32° to − 40°	72
Snow - - - - 2 parts Cryst. muriate of lime - 3	From + 32° to − 50°	82
Snow - - - - 3 parts Potash - - - - 4	From + 32° to − 51°	83

CHAINS, CABLES, AND ANCHORS.

Exhibitors.—**Bayliss, Simpson and Jones (5984), C. Bloomer and Co. (5994), G. H. Deeley and Co. (6034), Edge and Son (6046), J. Jones (6123), Wood Brothers (6260), Whaley, Burrows, and Fenton (6248).**

As examples of an important manufacture, the above may be referred to with satisfaction.

The first avowed proposal to substitute iron cables for cordage in the sea service is stated to be made by Mr. Slater, surgeon in the Navy, who obtained a patent for the plan in 1808, though he does not seem to have had the means of carrying it into effect. It was Lieut. Samuel Brown, of the Royal Navy, who, in January, 1808, had represented to the Naval Boards the policy of employing iron rigging and chain cable, and who, in February of that year, enrolled a patent for those articles, and in 1811 first employed chain cables in the vessel "Penelope," of which he was commander, for the purpose of experimental experience, this vessel of 400 tons having been fitted expressly for the trial by Captain Brown, Mr. Brunton, and other friends, at personal expense and risk, with iron rigging, chains, and cables, in place of hemp and rope.

He made a voyage in this ship from England to Martinique and Guadaloupe, and home again, in the course of four months, having anchored many times in every variety of ground without any accident. He multiplied his trials, and acquired certain proofs that iron might be substituted for hemp in making cables, not only for mooring vessels, but for the standing rigging. Upon his return from the West Indies, Captain Brown strongly represented the advantages practically experienced of iron over hemp. A committee of naval officers reported upon the whole affair, and the Government ordered the "Namur," of 74 guns, the "Monmouth," of 64, the "Crescent" frigate, and the "Alonzo" sloop, to be fitted with two chain cables, of 100 fathoms each, and Lieut. Brown was promoted to the rank of captain. These chains were of various forms of links; those, for instance, supplied to the "Crescent" were composed of very short links with parallel sides.

Since this period, chain cables have been universally introduced into all the ships of the Royal Navy; but the twisted links employed at first by Brown have been replaced by straight ones, stayed in the middle with a cross rod, the contrivance of Capt. Brown, which was secured by patent in this country.

It is not possible in this place to enter into any details of the manufacture of chain cables; but a statement of the operations may not be unsatisfactory. 1. The cutting, by a machine, of iron bars, in equal lengths, but with opposite bevels, to allow of the requisite crossing and splicing of the ends in the act of welding. 2. A reverberatory furnace (see IRON), in which a number of rods or round bars of the best possible wrought iron, and of proper dimensions, are heated to a red heat. The furnace is like those used in the sheet-iron works, but somewhat larger, and needs no particular description here. 3. The bending of each of these pieces by a machine, so as to form the links; the last operation is done rapidly, while the iron is red-hot. 4. The welding of the links at small forge fires, fitted with tools for this express purpose, and the immediate introduction of the stay, by a top tool and hammer. 5. Proving the cables by an hydraulic press, worked by a pump, with levers to ascertain the strain applied by working the pump. Any ordinary shears will do to cut the iron, if furnished with a gauge or stop, to regulate the length of link.

There are a few anchors exhibited in this Class; but beyond what has been already stated in the section devoted to Naval Architecture, &c, it does not appear necessary to extend our remarks. The use of chains in mines and collieries is happily extending. The following remarks by the managers of the Madeley Wood Colliery is much to the point.

"The Madeley Wood Company, Shropshire, substituted flat chains for flat ropes in their coal and ironstone pits forty-six years ago. The chains were made by Messrs. Edge, of Coalport. Chains of the same description are used in all the Shropshire collieries at the present time. The average depth of the pits in this district is about 200 yards, but some reach 300 yards, and flat chains are found to answer most satisfactorily in them. Since their introduction *no loss of life has occurred from their breakage*, and though the first cost is more than that of flat ropes adequate to the same labour, the saving in wear is very great. The pit in the Madeley Wood Colliery, now doing the greatest amount of work, is 220 yards deep, and out of it nine draughts of ironstone and spoil are drawn hourly, each draught averaging from 35 cwt. to 2 tons in weight.

THE PATENT HOIST GOVERNOR.

Exhibitor.—**Marcus Brown-Westhead (2244).**

This is exhibited in Class X., but it may be appropriately noticed in connection with the chains, &c., for mines and the like. The machine is attached to the upper side of the ascending and descending chamber or cage. It is simple in construction and easily kept in order, and has already proved itself in many instances to be a secure and efficient apparatus. No matter what the cause of the cage or box travelling at too great a speed, the expansion of the governor from an excessive rate of motion must, per force, operate upon the other portions of the machine, and thus permit the cams or wedges to be instantly projected against the uprights or guides of the shaft or well hole, and so arrest the box. A small weighted lever falls if the rope of suspension is severed, and thereby catches the box or cage, within a few inches, and that instantaneously. This is a double security in the event of the rope breaking, as the machine, in that case, does not depend upon the action of the governor alone. It has been proved that the greater the weight of the cage or box, and its contents, the more safely it is secured; for, the heavier the load, the greater will be the resistance of the cams, as they will take a much firmer hold of the guides or uprights. Some alteration of the plan makes this invention applicable to the *cages used in coal and other mines*, where it is essential that the momentum of the cage should be *gradually* reduced in the event of over-speed. This invention combines the peculiar and important advantage, viz., the springs to insert the cams are not brought into action except at the required time, thereby preserving their elasticity unimpaired.

There is also a plan for preventing accidents to railway platform lifts. These hoists are extremely dangerous, in consequence of the liability of one or more of the suspending chains breaking. By this invention the platform is evenly and simultaneously arrested at its four corners, in the event of one or all of the suspension chains being fractured by too great a load, or from the alternations of temperature affecting unequally the nature of the metal employed in the manufacture of the chains.

WIRE, WIREWORK, AND CONDUCTORS.

Exhibitors.—**W. Abbot (5968), Binks Brothers (5991), T. Bolton and Sons (5995), G. Buist (6008), J. Butler and Sons (6009), J. Cornforth (6024), Edelsten and Williams (6045), Edge and Son (6046), Elliot's Patent Sheathing and Metal Co. (6052), J. Geddes (6070), Glass, Elliott and Co. (6077), Greening and Co. (6083), N. Greening and Sons (6084), A. Grout (6036),**

Jenkins, Hill and Jenkins (6122), J. Reynolds (6192), W. Richards and Co. (6195), S. Robotham (6202), A. Rollason and Son (6205), F. Smith and Co. (6212), T. and W. Smith (6214), T. Standing (6217), J. Stephenson and Co. (6222), Walker and Clark (6238), Webster and Horsfall (6244), Harriet West (6247), Whaley, Burrows and Fenton (6248), Jeffrey and Jaffray (6121), Wilkins and Weatherley (6245), J. Ritchie (6198).

Wire ropes of various kinds are exhibited. They are of all sizes, from the fine sash and picture cord to the heavy round and flat rope for mining and other purposes. There are also some of the wire electric telegraph cables (these, however, will be described in connection with the telegraphs in the class devoted to Philosophical Instruments). The manufacture and appliance of wire rope having at the present time become one of so great importance, and the purposes for which it is used being so much more numerous than formerly, has led to the question—Cannot wire ropes be made of a more flexible nature than hitherto, and thus bring them into use for purposes which, up to the present time, they have been wholly unfit for? to some extent manufacturers have accomplished this object.

The steel wire for coal-pit ropes, exhibited by Webster and Horsfall, and by Shaw and Son, is a valuable introduction. The advantages of these ropes are, extreme strength, with extreme lightness, and great hardness with great tenacity. These qualities are possessed by the patent steel wire, to an extent far beyond that ever before attained. Its strength causes coal-pit ropes to be made only half the weight and thickness of the ordinary iron wire ropes. Its great hardness resists the abrasion caused by the friction of the pulleys, &c., to a remarkable extent; while its great tenacity prevents all brittleness. If these statements are confirmed, they remove the necessity of argument to show the saving effected in wear and tear of machinery, and proves the great durability of the wire.

Wire ropes are now employed for inclined planes, mines, collieries, ships' standing rigging, &c.

The following table shows the relative value of hemp, iron, and steel ropes.

ROUND ROPES.

Hemp.		Iron.		Steel.		Equivalent Strength.	
Circumference.	Its Weight per Fathom.	Circumference.	Its Weight per Fathom.	Circumference.	Its Weight per Fathom.	Working Load.	Breaking Strain.
Inch.	lbs.	Inch.	lbs.	Inch.	lbs.	Cwts.	Tons.
2¾	2	1	1	1	1	6	2
4½	5	1⅞	3	1½	1½	18	6
6	9	2⅜	5	1⅞	3	30	10
7	12	2⅝	7	2¼	4½	42	14
8	16	3⅛	9	2½	5½	54	18
10	26	4	14	3⅛	8	78	26
12	34	4⅝	20	3¾	12	120	40

FLAT ROPES.

4 × 1½	20	2½ × ½	11	..	..	44	20
6 × 1½	30	3½	18	2 × ½	10	64	28
8¼ × 2¼	40	3¾ × 11/16	22	2½ × ½	13	88	40
9 × 2½	50	4¼ × ¾	28	3	16	112	50
10 × 2½	60	4⅝	34	3½	20	136	60

John Reynolds is an exhibitor of specimens of wire flower-pot stands, &c., the special improvement of which consists in the application of *twisted* iron and twisted wire, adding very considerably to their ornamental appearance, while, by the use of machinery in the "twisting," very little additional cost is incurred. On the same principle specimens of rose temple archways are made.

Numerous manufactures in wire are exhibited; but they have no features of novelty, and they therefore require no notice, beyond the names of the exhibitors, which are given above.

ROLLED METALS AND GENERAL IRON-WARE.

Exhibitors.—T. Bolton and Sons (5995), Colebrookdale Co. (6019), Cooley and Fowke (6021), Cottamand Co. (6025), M. Feetham and Co. (6058), T. Gibson (6074), J. Green (6082), J. Gibbons (6072), Griffiths and Browett (6085), C. Jeakes and Co. (6119), J. and D. Jeavons (6120), W. R. Kennard and Co. (6127), A. Kenrick and Sons (6128), Lambert Brothers (6132), J. Moreton and Co. (6155), J. T. Plimley and Co. (6182), T. Potter (6183), W. Rocke (6203), E. and C. Toovey (6232), T. Whitfield and Co. (6251), J. Whitley (6252), G. Wright and Co. (6262), Wright and North (6264), Yates, Haywood and Drabble (6265), S. York and Co. (6267), Elliot's Patent Sheathing and Metal Co. (6052.)

Many of the articles which are grouped under these general headings, have been already described. Many of the ornamental castings merit the closest inspection; some of the smaller ones, exhibited by the Colebrookdale Co., are choice examples. Everything depends on the quality of sand used for the mould. The Mansfield sand, described in Class I., is celebrated as possessing many of the desired qualities, and to the use of this must be attributed the sharpness which so peculiarly distinguishes some of these castings. Cottam and Co. exhibit some superior examples of ornamental castings, and Messrs. Ritchie and Co. show an iron balcony, which, as a rough cast, is of great beauty. The lines are sharp and clear. This work is characterized by great cheapness.

In Class I., the peculiar excellence of the Low Moor iron was noticed, and the proof of that excellence is given in the spheres and hollow vessels which have been beaten out of sheets. Messrs. Griffiths and Browett are exhibitors of some remarkable examples of the ductility of this metal; jelly moulds, and every form of dish-covers, and similar articles, are shown as raised from the flat, without any breaking. This can only be effected by great knowledge of the character of the metal and by repeated annealing. These articles, and the finished tinned goods exhibited, should be carefully examined.

Amongst other matters, the variety of hardware manufactured in this country, and sold for use in foreign countries and the colonies, has many features of peculiar interest.

GALVANIZED IRON.

Exhibitors.—**S. Tonks (6231), E. Davies (6029), Morewood and Co. (6156).**

The coating of metals has been already noticed.

COPPER, ZINC, AND BRASS MANUFACTURES.

Exhibitors.—**Benhams and Froud (6280), Blews and Sons (6284), R. Evered and Son (6296), W. Greenway (6303), J. Hardman and Co. (6305), T. Harvey (6308), Hickling and Cox (6309), R. Pontifex and Sons (6337), W. Tonks and Sons (6354), J. Warner and Sons (6358).**

There is a large collection of articles exhibited by our coppersmiths, brassfounders, and general metal manufacturers. Many of these are of an excellent character; they display considerable manufacturing skill, excellent manipulation, and in many cases—not in all—the hand has been directed by a trained eye. The instances of bad taste are less numerous than they were in 1851. At the same time, it must be felt, that sufficient attention has not been given to the production of ornaments in a pure taste. Many of the more important articles which will be found in the collections by the above exhibitors have already received notice.

The moulds made in copper are fine examples of hammer work, and of the power of extending metals, when care is taken not to destroy the cohesive power by which the particles are held together.

When metals have been extended to a certain degree under the hammer, they become brittle, and incapable of being further extended without cracking. In this case the workman restores their malleability, sometimes by annealing, or, in other cases, by heating them red-hot and allowing them to cool slowly. The rationale of this process seems to be, that the hammering and extension of the metal destroys the kind of arrangement which the particles of the metal had previous to the hammering; and that the annealing, by softening the metal, enables it to recover its original structure.

Of late years a mode has been discovered of rendering cast iron malleable, without subjecting it to the action of puddling. The process is somewhat similar to that employed in annealing glass. The metal is kept imbedded in ground charcoal, or in powdered hæmatite, for several hours at a high temperature, and then allowed to cool slowly. In this manner vessels are made of cast iron, which can sustain considerable violence without being broken. Under this head we may include the following:—

TEA-URNS.

Exhibitors.—**Horsey and Baker (6315), E. Midwinter and Co. (6328), J. S. Pyrke and Sons (6339), W. Soutter (6346), J. Warner and Sons (6358.)**

MOULDS.

Exhibitors.—**J. Jenn, jun. (6318), A. Leale (6321).**

The remarks already made, and those on beaten iron, will sufficiently explain these manufactures. It is, however, felt that there is a great want of elegance of form in most of these articles.

CARPENTERS' AND SMITHS' TOOLS AND APPLIANCES.

Exhibitors.—**H. Wood Brothers (6260), T. White (6249), Watkins and Co. (6242), J. Reynolds (6191), J. C. Onions (6171), J. Neve and Co. (6165), J. Manger (6147), T. Linley and Sons (6139), James and Sons (6117), James Foundry Co. (6116), T. Henn (6100), Elliot's Patent Sheathing and Metal Co. (6052), Docker and Onions (6037), Brown, Lennox and Co. (6003), P. Wright (6263), M. Lloyd (6140), Watkins and Keene (6243), J. Warden and Sons (6256), G. Wright and Co. (6262), Wright and North (6264).**

Smiths' bellows, portable forges, anvils and vices, scarcely require, did they admit of any, especial notice. Cut nails, shoe bills, heel and toe tips, are not interesting, though they are very useful.

The self-boring wood screws exhibited are, however, a decided improvement upon anything in the shape of screws which have hitherto been given to the carpenter. It will be seen upon examination, that this power of self-boring depends upon carrying the screw directly to the end. In one case it will be perceived that the screw terminates in a point, and in the other that the end of the thread has a chisel termination; so that the wood is actually cut into by the slightest turn of the screw.

Of the building ironmongery little need be said. Did space admit of it, the screw-bench, exhibited by Brown, Lenox, and Co., should have been described, and also some other tools and appliances. The bolts and nuts exhibited by Watkins and Keene show the kind and quality of those used in the Exhibition building, the whole of which have been supplied by this company.

A split spike is exhibited by J. Warden and Sons which is deserving of notice. It is a nail consisting of two spikes; between these is placed an iron wedge. A small hole is made in the timber in which it is to be inserted. When the nail is struck in, the wedge forces the two spikes apart, and the nail is firmly fixed; it is useful for fixing rails, &c.

HYDRANTS—VALVES.

COCKS AND TAPS.

Exhibitors.—**J. Hickman (6310), Horsey and Baker (6315), S. Leoni (6322), Guest and Chrimes (6304), T. Lambert and Son (6320).**

A variety of most excellent fire-cocks, valves, and other arrangements for facilitating, regulating, and measuring the supply of water, will be found exhibited by Guest and Chrimes; amongst these may be especially noticed—

Siemens' Patent Balance Water-meter.—This meter is constructed upon the well-known principle of the Barker's mill, or turbine, and the measurement is effected without materially affecting the velocity or pressure. The measuring medium consists of a drum, working on an upright spindle at the bottom, and in a collar at the top. The water is conveyed by the conducting tube into the centre of the drum, and allowed to escape at three or more apertures in the periphery of the same, giving to it a rotatory motion. At each revolution of the drum a certain number of cubic inches of water is delivered, so that it is only necessary to register the number of revolutions to ascertain the quantity. This is effected by wheels driven by a screw worm on the top of the upright spindle, and the result indicated in gallons or cubic feet upon a graduated dial.

These exhibitors, and those with whom they are associated, display a considerable variety of cocks and taps. Leoni's composition taps ("Adamas," so called) appear likely to prove useful under many circumstances.

Lambert and Son show a valve which has many points to recommend it. This valve can be so adjusted that it will deliver any given quantity that may be named, and it will always deliver that quantity until the adjustment be altered, when it may be varied. These diaphragm valves have an established reputation.

HORSE-SHOES.

Exhibitors.—**Chillington Iron Co. (6016), W. Field and Son (6059), Lieut.-Colonel Fitzwygram (6064), E. Francis (6066), S. Guy (6087), W. D. Lines and Palmer (6138), W. Matthews (6150), D. Woodin (6261), T. A. Dollar (6038).**

Some fine specimens of workmanship are exhibited by Messrs. Dollar, of Bond Street, and Field and Son, of Oxford Street.

Messrs. Dollar exhibit shoes in their successive stages of manufacture, as well as specimens of the horse's foot with the shoe nailed on. Here may be seen the result of the consecutive process by which a bar of iron is cut into lengths, bent into the required curve, hammered to the proper thickness at the outer and inner margin, and punched with holes to admit the nails.

Messrs. Field show a specimen of each of the varieties of construction required to suit the shoe to the work to be performed by its wearer.

Lightness is the most important quality in the race-horse's shoe, generally known by the name of "plate." For the hunter, whose work has to be done on all descriptions of soil, from the flinty downs of Hampshire, to the deeply-cultivated clays of Essex, the main object is that the shoe shall be tightly fastened to the foot it protects; although a certain degree of lightness is desirable, it is less essential than in the case of the race-horse. The inner edge of the hind shoe of a hunter is smoothed or levelled in front, to lessen the risk of injury to the fore feet or legs from over-reach, an accident that the nature of the hunter's work renders him more liable to than any other horse.

In the shoe of the cart-horse, next in the series, lightness is still less a desideratum: durability and the power of retaining a grip of the ground on which the animal works, are the chief points to be attained. The first is insured by the massive dimensions of the shoe, and the second, in the case of the hind shoes, which are exposed to rougher usage than the fore ones (inasmuch as the hind feet are the fulcrum on which the mechanical act of draught chiefly depends), by each end of the shoe being furnished, on its under side, with a projection called a calkin, which catches any inequality of the ground or pavement on which the animal works.

In the same case is a "bar-shoe," or shoe whose hinder ends are joined by a cross-piece, suitable for cases of diseased hoof only admitting of a nail being driven in here and there. Also a shoe jointed at the toe, which is usually carried by hunting-men on their saddle to replace one if lost.

The only novelty in the art of shoeing horses is exhibited by the Chillington Iron Company, who propose to construct machine-made horse-shoes of wrought iron, in various sizes, only requiring to be heated in the fire, and adapted to the shape of the foot requiring shoeing. The principle is good, but judging from the specimens exhibited, some improvement is necessary to be made in the machinery before the shoe so constructed can be considered fit for general use.

To appreciate the advantage of this invention, it is only necessary to compare the cost of casting a piece of iron in the form of a horse-shoe, with that of first rolling out a bar and then working it by hand labour into horse-shoes. The machine-made shoes are analogous to this.

It is said to be proved by experiment that the shoes so made are as durable and as difficult to break as those wrought by hand. We have little experience of cast-iron shoes in England, but in Foreign countries where skilled labour is scarce and farriers few, great advantage has been derived from the use of these shoes.

The Chillington Company export their shoes largely to Egypt, where they are used in the Viceroy's army and have been found to answer well.

So great is the importance, to an army on service, of a constant and quickly-obtainable supply of shoes for its horses and beasts of burden, that results of the most material consequence may arise from the apparently trivial circumstance of the farriers being furnished with the ready-made and easily-fitted shoes; instead of being obliged, as heretofore, to hammer out, under the most unfavourable circumstances, and with short supplies of fuel, the unshaped bars of iron into properly-finished shoes that will protect and not lame the cavalry, artillery, and transport-horses.

Some day this invention may be of national importance. The machine employed by the Chillington Iron Company, is the invention of Henry Burden, of Troy, New York. As early as 1835 he took out a patent for a machine for making horse-shoes, which he improved upon in 1843, and this was turned to practical account by the production of a considerable number of horse-shoes. The present machine, however, which was patented in 1857, is entirely different from the former ones, and is a very remarkable piece of mechanism. In the previous machines the piece of iron bar of which the shoe was to be made was rolled into shape before being bent, and the pressure of the rollers being in the direction of its length, the bar, when it was pressed, was naturally rather extended in length than width, and the widening which is required at the crown of the shoe was not properly effected. By the present plan the bar, after being heated, enters the machine by a feeding apparatus; a piece of the required length is cut off, and, by a stroke from a piece of steel, shaped like the inside of a horse-shoe, is bent, and falls upon a die on a wheel beneath, corresponding to one on a cylinder above, and thus acquires by pressure the desired shape, two lateral strikers at the same moment hitting the extremities, or heels, of the shoe, and driving them inwards into the required shape. Thence it passes between another pair of dies, where it is stamped, and by an ingenious arrangement is flattened from the curled shape which the wheel gives it as it falls at the mouth of the machine. The shoes thus made are remarkable for their exactness in shape and in the position of the holes—a most important point with regard to the safety of horses' feet; and they can be produced, when the machine is in proper order, at the rate of 60 per minute, which is more than two men can forge in a day, and the superiority over shoes forged by hand is very striking. As the bar is bent before being pressed in the die, the pressure at the crown is in the direction of the width, and hence the widening is readily effected.

STABLE FITTINGS.

Exhibitors.—**W. Owen (6173), Musgrave Brothers (6159), T. Hood and Son (6106), Cottam and Co. (6025), J. Barton (5983), Hallen and Hallen (6091), St. Pancras Iron Work Co. (6209), J. Carrington (6011), T. and C. Clark (6018).**

The most prominent feature in the articles exhibited is the application of enamelled iron. In most cases the fittings are so arranged that they can be readily taken in pieces for removal. All these arrangements are well worthy of examination by those to whom the cleanliness of the stable, and consequently the health of the horse, is an object of interest.

MINCING MACHINES AND MILLS.

Exhibitors.—**S. Nye and Co. (6170), J. McMorran (6145), A. Lyon (6143), T. Lloyd and Sons (6141), G. Fieldhouse and Co. (6060), E. Dowling (6040), T. Burchfield and Son (6007), T. Smith (6213), W. J. Gingell (6076).**

Fieldhouse and Co. are large exhibitors; amongst other things may be named their ornamental steel grocer's stand coffee mill, with two 5 feet 2 inch fly-wheels, fluted brass hopper, and fitted with gun-metal bushes, and gun-metal external bearings, to support the fly-wheels. The last-named arrangement cannot be too strongly recommended, as it insures the concentricity of the grinding parts, and, consequently, great durability, and is much superior to the anti-friction wheel arrangement, which is generally adopted for the same purpose.

The domestic flour mill, exhibited by the same firm, can be worked by a boy. A bushel of wheat ground by this mill will produce 30 lbs. of fine flour, 13 lbs. of seconds, 9 lbs. of sharps, and 10 lbs. of pollard and bran; and will grind a third of a bushel of wheat in an hour. A great improvement in these mills is the facility with which the cylinder can be removed, by opening the door at the end of the machine, and drawing it out. These mills can be made to separate the pollard from the bran, if required.

Smith, of Wolverhampton, exhibits excellent mills from the manufactory of Mr. Corns, of that town. The other exhibitors of mills and mincing machines do not appear to present any novelties in their construction. They are all excellently made; they are generally highly decorated, but not always in the best taste. W. J. Gingell is the exhibitor of a model of a corn-meter. (*See* Class IX.)

BALANCES, WEIGHING-MACHINES, AND WEIGHTS.

Exhibitors.—**W. and T. Avery (5975), E. Dowling (6040), J. Elliot (6051), Kington and Trowbridge (6130), T. Medhurst (6153), R. V. Titford and Co. (6230), H. Winter (6258), J. Bartlett and Son (5982), Day and Millward (6031), W. F. Casey (6013)**

The beam of a good balance ought to be a bar or double cone of metal, of such strength as to secure perfect inflexibility under any load which may be fitly applied to its extremities. Its arms should be quite equal in weight and length upon each side of its point of suspension; and this point should be placed in a vertical line over the centre of gravity; and the less distant it is from it, the more delicate will be the balance. Were it placed exactly in that centre, the beam would not spontaneously recover the horizontal position, when it was once removed from it. To render its indications more readily commensurable, a slender rod or needle is fixed to it, at right angles, in the line passing through its centres of gravity and suspension. The point, or rather edge, of suspension, is made of perfectly hard steel, and turns upon a bed of the same. For common uses the arms of a balance can be made sufficiently equal to give satisfactory results; but, for the more refined purposes of science, that equality should never be presumed nor trusted to; and, fortunately, exact weighing is quite independent of that equality. To weigh a body is to determine how many times the weight of that body contains another species of known weight, as of grains or pounds, for example.

The principle of the steel-yard is that of the lever; a certain length of arm indicating the power necessary to lift or to balance another weight. This is sometimes called the Roman balance, probably from its having been employed by the Romans to determine the weight of bodies.

Weighing-machines are usually dependent upon the action of a well-tempered spring. This may be either a helix, which is elongated in regular proportions by the weight applied; or it may be an ordinary spring, which is bent by the weight suspended from it. In either case, an index marks upon a dial the amount of deflection and consequently indicates the weight.

The machines and balances exhibited are fine specimens of manufacture.

BELLS.

Exhibitors.—C. Dickie (6292), J. Taylor and Co. (6351), J. Warner and Sons (6358).

The bells exhibited by Warner and Sons must be regarded as fair examples of the art of bell making in this country. It is evident that, for ordinary bells, the usual practices are sufficiently good to insure a good tone; but it is also clear that our bell-founders have yet to learn the true relations the metals, which form the bronze or bell metal, bear to each other, and their combined relation to heat; so that a perfectly homogenous alloy may be secured, and, at the same time, such perfect fluidity as will insure the rapid filling of the mould, and a uniform rate of cooling.

The following are the weights of a few of the largest bells:—

	lbs.
The great bell of Moscow - -	443,772
The bell of St. Ivan - - -	127,836
Another bell in the same city -	39,827
Ditto, ditto, cast in 1819	112,000
The bell in the cathedral, Paris -	38,800
Ditto, ditto, Vienna - -	39,648
The bell in the church at Erfurt -	30,800
Great Tom of Oxford - -	17,000
Ditto, ditto, Lincoln - -	9,894
The bell of St. Paul's, London -	8,400

Mr. Taylor's frame of bells present no peculiar novelty. Bell-hanging finds its illustration in the exhibition of C. Dickie.

The bronze of bells, or bell metal, is composed, in 100 parts, of copper 78, tin 22. This alloy has a fine compact grain, is very fusible and sonorous. The other metals sometimes added are rather prejudicial, and merely increase the profit of the founders. Some of the English bells consist of 80 copper, 10·1 tin, 5·6 zinc, 4·3 lead; the latter metal, when in such large quantities, is apt to cause isolated drops, hurtful to the uniformity of the alloy.

TRAPS.

Exhibitors.—G. H. Ellis (6054). H. Lane (6133), C. Pullinger (6187).

The most important of these collections is that of H. Lane, who exhibits several kinds of fox and vermin traps, warranted to catch the animal, whatever it may be. Some of these traps are designed for the larger beasts of the forest, and are certainly anything but agreeable playthings. Pullinger's mouse-trap is exceedingly ingenious; each unfortunate mouse, when caught, resetting the trap, and serving himself as a lure to his brethren.

KNIFE AND BOOT AND SHOE CLEANING MACHINES.

Exhibitors.—**A. Dixon (6035), G. K. Ellis (6054), Hilliard and Chapman (6104), G. Kent (6129), J. Neve and Co. (6165). J. Reynolds (6192), J. W. Scott (6210).**

The knife-cleaning machines proceed upon the general principle of employing some abrasive substance, such as emery powder, grit-stone, or the like. The knife is usually fixed, and, the polishing powder being spread upon a disc, is rapidly rotated. The boot and shoe cleaning machines have much ingenuity, but they do not appear likely to supplant the labour of the living shoe-black.

Mr. Kent certainly exhibits a considerable variety of articles calculated, as he says, "for promoting domestic economy."

MILITARY ORNAMENTS.

Exhibitors.—**Hammond, Turner and Sons (6093), Iliffe, and Player Brothers (6113).**

These may be regarded as varieties of that stamped and chased ware, for which Birmingham is celebrated, and which has been already noticed.

ELECTRO-PLATED GOODS.

The Wolverhampton Electro-plate Company are exhibitors in the Wolverhampton Court. Buxton and Co. display their plate in the midst of cutlery and edge tools. This want of system in the arrangement of manufactures is deeply to be regretted. The educational purposes of this great gathering are entirely lost by the practice; and no opportunity is afforded to the public of carefully comparing one manufacturer's goods with those of another.

Electro-plate will be noticed in its proper place, in Class XXXIII., when the Sheffield plate will also be described.

FENDERS AND FIRE-IRONS.

Exhibitors.—**H. E. Hoole (6108), T. F. Jones and Sons (6125), J. Morton and Son (6158), Steel and Garland (6221), Stuart and Smith (6223), A. Gray and Son (6081), T. Hague (6088), J. C. Onions (6171).**

KETTLES AND COAL-SCOOPS.

Exhibitors.—**R. Midwinter and Co. (6328), J. S. Pyrke and Sons (6339), W. Soutter (6364).**

FIRE-GUARDS.

Exhibitors.—**W. Edwards (6048), W. H. Thomas (6229).**

It is not easy to particularize any set for description. There is certainly considerable differences in the taste displayed in the designs of these articles. Some of the fenders exhibited by Mr. Hoole are really works of art. Many of those exhibited by other manufacturers are splendid; but that splendour, arising from the overlaying ornament, in too many cases impairs their utility. This work is not, however, intended to criticise, and in articles of so well-known a character it is not necessary to expend space in useless remarks.

BRONZES.

Exhibitors.—**J. Defries and Sons (6291), Rennie and Adcock (6341).**

There are, independently of those already named, some good examples of castings in bronze, to be applied to art manufactures. The examples by those exhibitors are worthy of much commendation.

HOOKS AND EYES

are associated with NEEDLES and FISH-HOOKS, in this Class; but it is thought advisable to postpone any consideration of them until those exhibited in Class XXXII., STEEL, are brought under notice.

There are in this Class a most miscellaneous series, to which no especial place can be given, or to which no particular explanation can apply. Amongst others will be found—

GOFFERING AND CRIMPING IRONS.

Exhibitor.—**G. W. Ingram (6114).**

CHIMNEY-SWEEPING AND DRAINING MACHINERY.

Exhibitor.—**R. Barrett and Sons (5981).**

The often useful but rarely elegant appendages—

DOG-COLLARS, HANDCUFFS, LEG-IRONS, &c.

Exhibitors.—G. Evans (6055), Hiatt and Co. (6102).

BRANDING IRONS.

Exhibitors.—E. and W. Dobson (6035), R. Hall (6090).

HAT AND UMBRELLA STANDS.

Exhibitors.—Peyton and Peyton (6177), Redmayne and Co. (6190).

VANES AND WEATHERCOCKS.

Exhibitor.—A. Leale (6321).

BOTTLING MACHINE.

Exhibitor.—W. Gillett (6075).

PLUMBING.

Exhibitors.—Beard and Dent (6374), J. J. Lovegrove (6384).

Mr. Lovegrove well illustrates the plumber's handicraft, from the 14th century, to the present time. Beard and Dent show several plumbing appliances.

ALUMINIUM.

Exhibitors.—Mander, Weaver and Co. (6146).

This metal has been fully described in Class I. These exhibitors show a casket in the Italian style of ornamentation; this has been made by the process of casting, and is valued at 150*l*.

PRESSES AND DIES.

Exhibitors.—R. Nash (6160), P. Rogers and Co. (6204.)

MEDALS AND COINS.

Exhibitors.—R. Heaton and Sons (6099), T. Ottley (6172).

Seeing that the process of striking medals is constantly going forward in the Process Court, it will be unwise to describe the art in this section.

RAILWAY APPLIANCES.

Exhibitors.—J. Warden and Sons (6241), C. Bloomer and Co. (5994), J. Palmer and Sons (6174), Bayliss, Simpson and Jones (5984).

Under this head will be found exhibited a variety of tools useful in laying rails, and necessary in railway operations.

GAS-METERS, FITTINGS, &c.

Exhibitors.—Alder (6277), Bischoff, Brown and Co. (6283), W. and B. Cowan (6288), Croll and Rait (6289), Duckham (6294), Edge and Co. (6295), G. Glover and Co. (6300), T. Glover (6301), Hulett and Co. (6317), W. Richards (6342), W. Strode (6349), W. Sugg (6350), Underhay (6355).

The Gas-meters may be divided into three classes: 1st, the dry Gas-meter, that is, a meter worked by mechanical means, and without the aid of water; 2nd, the ordinary water-meter; and, 3rd, the compensating water-meter, either floating or otherwise. The dry meters exhibited consist of two principles: the first, exhibited by Mr. T. Glover (6301), consists of a cylinder similar to that of a high-pressure steam-engine doubled, that is to say, a cylinder with a solid partition in the middle, and a flexible diaphragm on each side of this partition: these diaphragms are each provided with slide valves similar to those of a steam engine; and the gas being conducted by this means into the chambers, they are filled and displaced with gas alternately: this motion is communicated, and drives a train of wheel-work, upon which the quantity of gas passed through the measuring chambers is registered.

The meters exhibited by Croll and Rait (6289), W. Richards (6342), G. Glover, and Co. (6300), are all of a similar action.

The second principle is that exhibited by W. Sugg (6350): it consists of three flexible diaphragms, each provided with a slide valve similar to that of a steam engine, alternately working backwards and forwards, and thus displacing certain volumes of gas at each stroke, communicating a rotary motion to a crank fixed in the centre of the plate, dividing the measuring compartments from the chamber to which unregistered gas is admitted; this crank in its turn giving motion, by a worm and wheel-work, to the index upon which the quantity of gas passed through the measuring chambers is recorded.

The ordinary water-meter is too well understood to require any comment. The fault of the ordinary water-meter is the variation in the water line; and to overcome this a number of contrivances have been suggested—such as the rotary motion of the drum causing a small quantity of water to be lifted at each revolution, and deposited into a chamber in which the drum or measuring part of the meter works. But a more perfect plan to overcome the variations of the water level is that exhibited by Bischoff and Brown (6283), which consists of a floating drum, or measuring chamber, so that if the water evaporates the drum will sink; and if from condensation the water rises, the drum will rise in the same proportion, thus always having a perfect water level, and consequently a perfect measuring chamber. The principle of this drum is a series of eccentric chambers placed round a central air-vessel, which permits it to rise and fall according to the level of the water in the meter-case.

The lava gas-burners exhibited by W. Sugg (6350) are well worthy of mention, as being a much better substance than metal for the purpose of making gas-burners; the flame produced is better, and as the lava does not oxidise, the burner lasts longer, and maintains a better flame than the metal burner

The "Sunlight" exhibited by W. Strode (3649) is an exceedingly good plan of lighting large buildings, and to this great advantage W. Strode has added his invention of self-ventilation, which opens a valve immediately the gas is turned on, and closes it as soon as it is shut off; thus, when the necessity arises for ventilation, the valve opens, and when it is no longer required, and the gas shut off, the ventilator valve closes.

Mr. Duckham (6294) is an exhibitor of a safety gas water regulator, by which are obtained all the advantages of Crosley's Water Governor, but is enclosed in a case; and thus, if the water in the outer case becomes evaporated, and the gas escapes, it is confined to the case, so that no accident could arise from escape of gas.

END OF VOLUME I.

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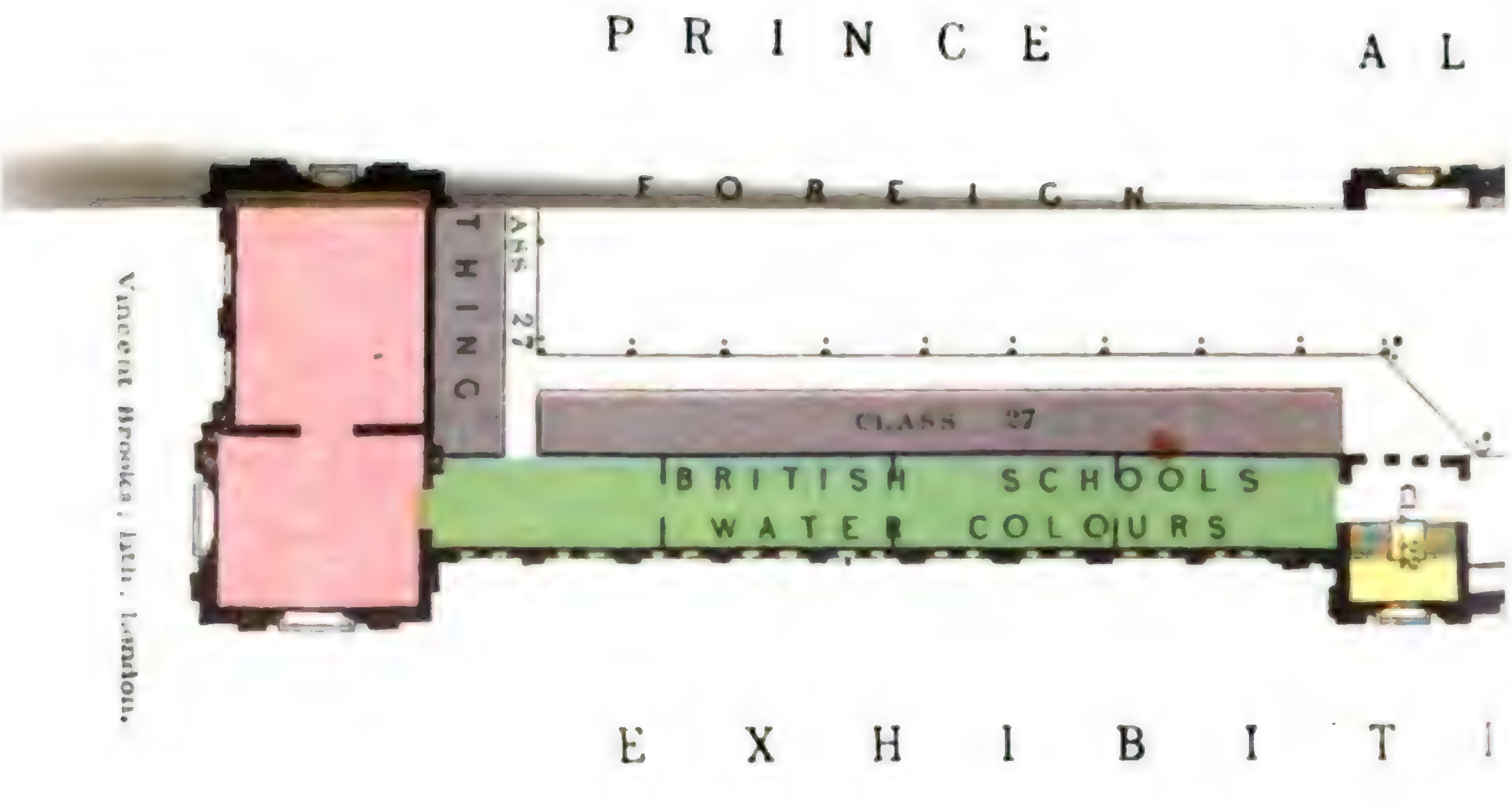
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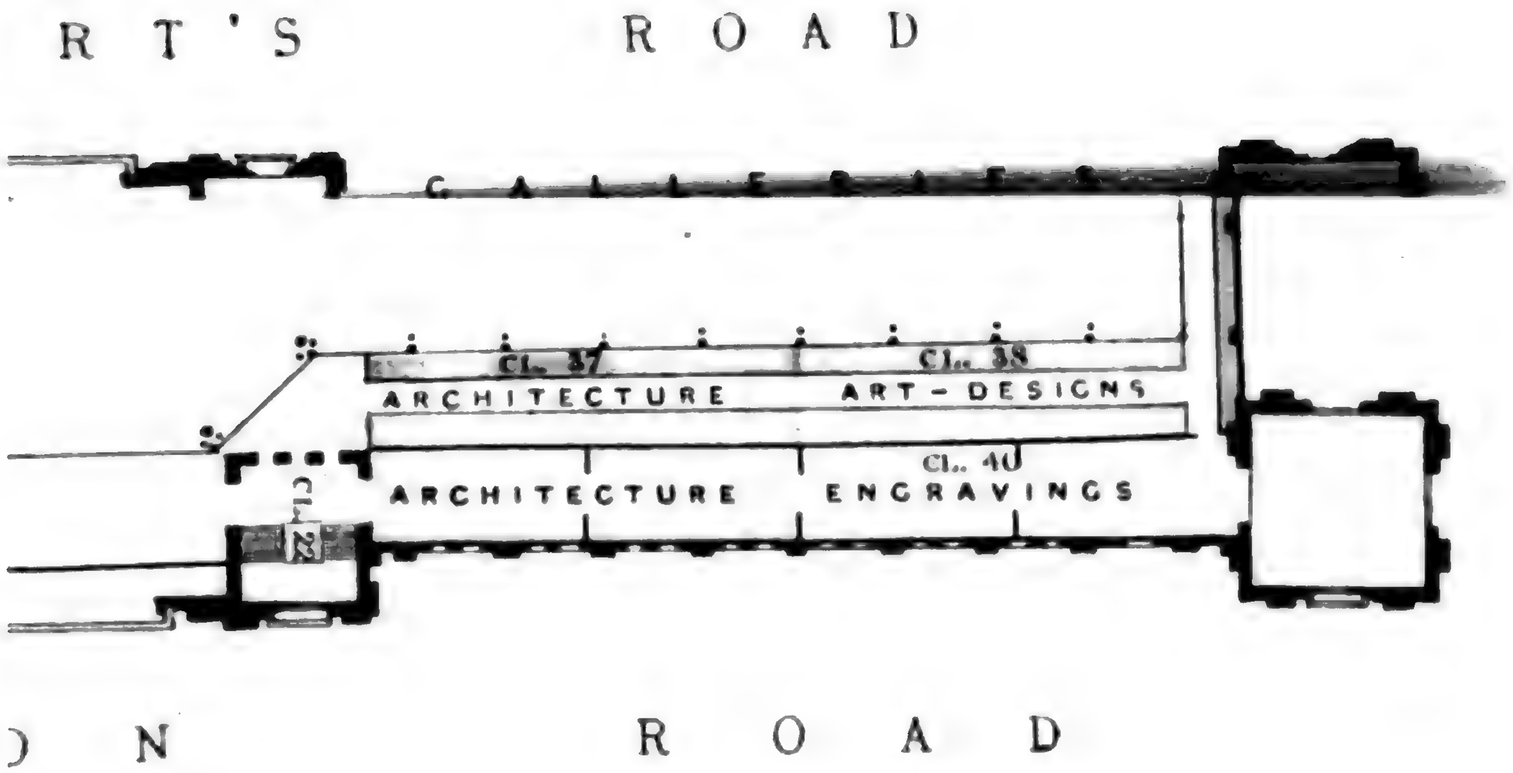
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CL. 37
CL. 38
ARCHITECTURE
ART-DESIGNS
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CL. 22
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HANDBOOK

TO THE

INDUSTRIAL DEPARTMENT

OF THE

International Exhibition,

1862.

By ROBERT HUNT, F.R.S., F.S.S.
KEEPER OF MINING RECORDS.

Published with the AUTHORITY OF HER MAJESTY'S COMMISSIONERS, *and Sold within the Building by their Sanction.*

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INDEX TO VOL. II.

	CLASS.	SITUATION.	PAGE
Æolian harps	XVI.	*North Court*	138
African Colonies	Colonies	*N.-east Transept*	397
Agricultural implements	France	*South-west Court*	443
Agricultural implements	Han. Town	*S.-west Transept*	498
Agricultural machinery	U. States	*South-east Tower*	542
Agriculture (Newfoundland)	Colonies	*N.-east Transept*	373
Agriculture	Spain	*South-west Court*	529
Albion printing press	VII.	*Process Court*	37
Algeria	F. States	*South-west Court*	457
Amber	Hn. Towns	*S.-west Transept*	497
Amber	Russia	*North-west Court*	525
Amber beads	Turkey	*North-west Court*	540
Amethyst	XXXIII.	*South Court*	118
Anemometer	XIII.	*Nave*	202
Anhalt-Bernburg	Zollvern.	*S.-west Transept*	494
Anhalt-Dessau-Cöthen	Zollvern.	*S.-west Transept*	494
Antimony (Victoria)	Colonies	*N.-east Transept*	321
Antiquities from the Viceroy's New Museum	Egypt	*North Gallery*	425
Apparatus used in comparing thermometers with standard	XIII.	*Nave*	204
Archil colours	XXIII.	*South-east Gallery*	258
Armour (India)	Colonies	*N.-east Transept*	391
Arrack punch	Sweden	*North-west Court*	532
Arrowroot (Queensland)	Colonies	*N.-east Transept*	341
Articles of Clothing	XXVII.	*South Gallery*	275
Artificial gems	XXXIII.	*South Court*	124
Artificial limbs, eyes, &c.	XVII.	*Gallery N. Court*	215
Artificial pearls	XXXIII.	*South Court*	124
Atmospheric electricity	XIII.	*Gallery N. Court*	169
Atmospheric electrometer	XIII.	*Gallery N. Court*	170
Australian Colonies	Colonies	*N.-east Transept*	284
Australian gold-washing machinery	Colonies	*N.-east Transept*	322
Austria	Germany	*South-west Court*	457

	CLASS.	SITUATION.	PAGE
Babbage's calculating engine	XIII.	*Gallery N. Court*	167
Baden, Grand Duchy	ZOLLVERN.	*S.-west Transept*	494
BAHAMAS	COLONIES	*N.-east Transept*	385
Baking of Parian	XXXV.	*South Court*	74
Bank-note engraving	Sub-class XXVIII.C.	*Gallery N. Court*	228
BARBADOS	COLONIES	*N.-east Transept*	379
BELGIUM	F. STATES	*Northern Courts*	403
Benson's clock	XV.	*Gallery N. Court*	206
BERMUDA	COLONIES	*N.-east Transept*	384
Bessemer steel	XXXII.	*Transept & South Court*	6
Binocular microscopes	XIII.	*Gallery N. Court*	179
Block-printing	Sub-class XXVIII.C.	*Gallery N. Court*	227
Boilers	FRANCE	*Western Annex*	436
Boiler, high pressure	ZOLLVERN.	*Western Annex*	490
Bonnets and general millinery	Sub-class XXVII.B.	*South Gallery*	275
Bookbinding	Sub-class XXVIII.D.	*Gallery N. Court*	231
Bookbinding	AUSTRIA	*N.-west Transept*	476
Books, maps, and diagrams	Sub-class XXIX.A.	*Central Tower*	238
Boots and shoes	Sub-class XXVII.D.	*South Gallery*	275
BRAZIL	F. STATES	*Central Avenue*	415
Breviary	ROME	*South Court*	522
Brick-making machine	ZOLLVERN.	*Western Annex*	490
Bridges, model of	AUSTRIA	*N.-west Transept*	465
Britannia metal	XXXIII.	*South Court*	105
BRITISH COLUMBIA	COLONIES	*N.-east Transept*	375
BRITISH GUIANA	COLONIES	*N.-east Transept*	376
Brunswick, Duchy of	ZOLLVERN.	*S.-west Transept*	495
Brushes	XXV.	*Transept S. Court*	163
Brushes	AUSTRIA	*N.-west Transept*	474
Buhl Parqueterie	XXX.	*North Court*	145
Burra-Burra Mines	COLONIES	*N.-east Transept*	288
Button manufacture	XXXII.	*South Court*	18
Calico-printing machinery	ZOLLVERN.	*Western Annex*	491
Calicoes, shirtings, linings, &c.	XVIII.	*South Gallery*	262
Cameras, apparatus, and tents	XIV.	*Central Tower*	252
CANADA	COLONIES	*N.-east Transept*	346
Candles	BRAZIL	*Central Avenue*	418
CAPE OF GOOD HOPE (Natal)	COLONIES	*N.-east Transept*	399

	CLASS.	SITUATION.	PAGE
Cairngorms	XXXIII.	*South Court*	119
CARPETS	AUSTRIA	*N.-west Transept*	473
Carpets	XXII.	*Gallery Walls*	280
Carpets	FRANCE	*South-west Court*	450
Carpets	TURKEY	*North-west Court*	541
Carpet weaving	U. STATES	*Western Annex*	542
Carriage	MECKLENBURG SCHWERIN.	*S.-west Transept*	497
Carriages	NETHERLANDS	*North-west Court*	512
Carriages and sledges	RUSSIA	*North-west Court*	527
Carved oak sideboard	XXX.	*North Court*	143
Carved writing table	XXX.	*North Court*	149
Carving in wood	GREECE	*North-west Court*	500
Castings	SWEDEN	*North-west Court*	534
Castings, iron, &c.	PRUSSIA	*S.-west. Transept*	493
Cast-steel	XXXII.	*Transept & South Court*	2
Cast-steel	XXXII.	*Transept & South Court*	9
Cast-steel goods	XXXII.	*South Court*	26
Cat's eye	XXXIII.	*South Court*	120
Caughley pottery	XXXV.	*South Court*	88
Cemented or converted steel	XXXII.	*Transept & South Court*	2
CENTRAL AFRICA	F. STATES	*Northern Courts*	402
Centrifugal pump	FRANCE	*Western Annex*	440
Cereals	RUSSIA	*North-west Court*	526
CEYLON	COLONIES	*N.-east Transept*	394
"Challenge" cornet-à-piston, with the "champion" valves	XVI.	*North Court*	136
CHANNEL ISLANDS	COLONIES	*N.-east Transept*	401
Chemical and pharmaceutical products	PORTUGAL	*Central Avenue*	518
Chemical products	FRANCE	*South-west Court*	430
Chemical stoneware	XXXV.	*South Court*	69
Chemicals and surgical glass	XXXIV.	*South Court*	54
Chemicals	BAVARIA	*S.-West Transept*	494
Chemicals	SPAIN	*South-west Court*	529
CHINA	F. STATES	*North Court*	419
China, painting on	BAVARIA	*S.-west Transept*	494
Chocolates and spices	NETHERLANDS	*North-west Court*	512
Chromatic printing	Sub-class XXVIII.c.	*Gallery N. Court*	229
Chronometers	XV.	*Gallery N. Court*	208
Chronometer	NETHERLANDS	*North-west Court*	512
Chrysolite, peridot, olivine	XXXIII.	*South Court*	120

	CLASS.	SITUATION.	PAGE
Chrysoprase	XXXIII.	*South Court*	119
Church decorations	XXX.	*North Court*	153
Cigars and tobacco	Russia	*North-west Court*	526
Cigars	Hn. Towns	*S.-west Transept*	498
Cinnamon (Ceylon)	Colonies	*N.-east Transept*	394
Clay pipe-making	XXXII.	*Process Court*	31
Clocks and watches	Austria	*N.-west Transept*	469
Clocks and watches	XV.	*Gallery N. Court*	211
Clothing	France	*South-west Court*	452
Clothing	Greece	*North-west Court*	500
Coalport pottery	XXXV.	*South Court*	86
Coals (New South Wales)	Colonies	*East Dome Nave*	306
Coals	Spain	*South-west Court*	528
Coal (Tasmania)	Colonies	*N.-east Transept*	332
Coal (Victoria)	Colonies	*N.-east Transept*	323
Cobalt (Jamaica)	Colonies	*N.-east Transept*	380
Colza (rape oil)	Austria	*N.-west Transept*	461
Cochin China	French Colony	*South-west Court*	456
Cocoa	Ecuador	*North-east Court*	424
Cod-liver oil (Newfoundland)	Colonies	*N.-east Transept*	372
Coffee	Brazil	*Central Avenue*	417
Coffee	Liberia	*North Court*	509
Coffee (Queensland)	Colonies	*N.-east Transept*	342
COLONIAL POSSESSIONS	Colonies	*N.-east Transept*	284
Coloured glass	XXXIV.	*South Court*	46
Compasses and surveying instruments	XIII.	*Gallery N. Court*	186
Comparative table of the weights and prices of cast-steel bells	XXXII.	. . .	13
Composition of emeralds	XXXIII.	*South Court*	117
Composition of glass	XXXIV.	*South Court*	44
Concertinas	XVI.	*North Court*	138
Converting steel	XXXII.	*Transept & South Court*	7
Copper	Portugal	*Central Avenue*	517
Copper and steel-plate printing	Sub-class XXVIII.c.	*Gallery N. Court*	229
Copper (Canada)	Colonies	*N.-east Transept*	347
Copper (New South Wales)	Colonies	*East Dome Nave*	308
Copper ores (Jamaica)	Colonies	*N.-east Transept*	379
Copper ores, &c.	Spain	*South-west Court*	529
Coral fishery	XXXIII.	*South Court*	122
Coral ornaments	Italy	*South Court*	505
Corals	XXXIII.	*South Court*	121
COSTA RICA	F. States	*Horticultural Ent.*	419

	CLASS.	SITUATION.	PAGE
COTTON	AUSTRIA	*N.-west Transept*	471
Cotton	XVIII.	*South Gallery*	260
Cottons	FRANCE	*South-west Court*	449
Cotton	ITALY	*South Court*	502
Cotton	LIBERIA	*North Court*	509
Cotton	PORTUGAL	*Central Avenue*	518
Cotton	SWEDEN	*North-west Court*	533
Cotton	VENEZUELA	*North-west Court*	544
Cotton	W. AFRICA	*Northern Courts*	103
Cotton and Flax	SPAIN	*South-west Court*	529
Cotton and silks	BRAZIL	*Central Avenue*	418
Cotton and silk goods	PORTUGAL	*Central Avenue*	520
Cotton (Ceylon)	COLONIES	*N.-east Transept*	395
Cotton (Jamaica)	COLONIES	*N.-east Transept*	381
Cotton (Natal)	COLONIES	*N.-east Transept*	378
Cotton-spinning	SWITZERLAND	*North-west Court*	538
Counterpanes, dimities	XVIII.	*South Gallery*	262
Currying	XXVI.	*Transept S. Court*	165
Cut and engraved glass	XXXIV.	*South Court*	51
Cutlery	AUSTRIA	*N.-west Transept*	481
Cutting the Koh-i-noor	XXXIII.	*South Court*	111
Damasks	XIX.	*South Gallery*	274
Decarbonization of iron	XXXII.	*Transept & South Court*	8
Delf ware	XXXV.	*South Court*	79
DENMARK	F. STATES	*North-west Court*	420
Dentistry	XVII.	*Gallery N. Court*	216
Description of Willis's organ	XVI.	*North Court*	139
Diamond cutting	XXXIII.	*South Court*	109
Diamonds	XXXIII.	*South Court*	106
Diamonds (Victoria)	COLONIES	*N.-east Transept*	323
Diaper	XIX.	*South Gallery*	274
Die sinking	VII.	*Process Court*	34
Dip circle with Rev. Dr. Lloyd's adjustment	XIII.	*Nave*	200
Dipping-needle	XIII.	*Nave*	201
DOMINICA	COLONIES	*N.-east Transept*	383
Double-bass, with apparatus for producing enharmonic scales of harmonics	XVI.	*North Court*	137
Double tension or compressed pianoforte (the)	XVI.	*North Court*	131
Dowak D-yuno	COLONIES	*Nave E. Transept*	299
Drain and sanitary pipes	XXXV.	*South Court*	68
Dressing-cases and toilet articles	Sub-class XXXVI.A.	*Gallery N. Court*	282

	CLASS.	SITUATION.	Page
Drinking-horns	Denmark	*North-west Court*	423
Dugong oil (Queensland)	Colonies	*N.-east Transept*	343
Duryea Mining Company	Colonies	*N.-east Transept*	291
Dyeing and cleaning	XXIII.	*South-east Gallery*	259
Dyeing and finishing velvet	XXIII.	*South-east Gallery*	259
Dyeing and printing	Austria	*N.-west Transept*	473
Dyeing and re-watering moiré-antiques	XXIII.	*South-east Gallery*	259
Dyeing, cleaning, and embossing satins	XXIII.	*South-east Gallery*	259
Dyeing lichens (Ceylon)	Colonies	*N.-east Transept*	395
Earthenware	XXXV.	*South Court*	70
East Indian Group	Colonies	*N.-east Transept*	386
Ecclesiastical Society's Court	XXX.	*North Court*	152
Ecuador	F. States	*North-east Court*	424
Edged tools	Austria	*N.-west Transept*	481
Educational apparatus generally	Sub-class XXIX.b.	*Central Tower*	239
Educational Works and Appliances	XXIX.	*Central Tower*	237
Educational works	Austria	*N.-west Transept*	477
Educational works	Belgium	*Northern Court*	414
Educational works	Russia	*Northern Court*	526
Educational works and appliances	France	*South-west Court*	452
Education of the deaf and dumb	Sub-class XXIX.d.	*Central Tower*	247
Egg-shell china	XXXV.	*South Court*	91
Egg-shell china	Denmark	*North-west Court*	421
Egypt	F. States	*North Gallery*	426
Electrical appliances	XVII.	*Gallery N. Court*	218
Electrical clock	XV.	*Gallery N. Court*	212
Electro-deposited bronzes	XXXIII.	*South Court*	97
Electro-plated goods and gilt metal	XXXIII.	*South Court*	102
Electro-plating	XXXIII.	*South Court*	104
Electro-telegraphic apparatus and appliances	XIII.	*Gallery N. Court*	174
Elizabethan furniture	XXX.	*North Court Nave*	147
Embroidered stuffs	Turkey	*North-west Court*	541
Embroidery	Greece	*North-west Court*	500
Embroidery	Ecuador	*North-east Court*	424
Embroidered vestment	XXIV.	*South-east Gallery*	265
Emeralds	XXXIII.	*South Court*	116
Enamel painting	XXXV.	*South Court*	85
Encaustic tiles	XXXV. & X.	*South Court*	65

	CLASS.	SITUATION.	PAGE
Encaustic tiles	XXX.	*North Court*	157
Engineering	Italy	*South Court*	504
Engineering	Austria	*Western Annex*	463
Engraved glasses	Netherlands	*North-west Court*	511
Engraved and ornamental glass	Brazil	*Central Avenue*	418
Enlarged portraits	XIV.	*Central Tower*	254
Essential oils	Colonies	*N.-east Transept*	329
Eyes, hooks, pins, buttons, and studs	XXXII.	*South Court*	14
False topaz	XXXIII.	*South Court*	119
Fancy stationery	Sub-class XXVIII.B	*Gallery N. Court*	223
Feathers	Sub-class XXV.B.	*Transept S. Court*	161
Fermented drinks	Brazil	*Central Avenue*	418
Fibres (India)	Colonies	*N.-east Transept*	392
Fibres (Mauritius)	Colonies	*N.-east Transept*	396
Fibres (Victoria)	Colonies	*N.-east Transept*	329
Fibres	Liberia	*North Court*	509
Files and other tools	XXXII.	*South Court*	20
Filters and filter fountains	XXXV.	*South Court*	38
Fire-arms	Belgium	*Northern Courts*	409
Fishes (Nova Scotia)	Colonies	*N.-east Transept*	367
Fisheries (Canada)	Colonies	*N.-east Transept*	354
Fisheries (New Brunswick	Colonies	*N.-east Transept*	363
Fishing-net loom	France	*Western Annex*	441
FLAX AND HEMP	XIX.	*South Gallery*	272
Flax	Austria	*N.-west Transept*	462
Flax	Belgium	*Northern Courts*	406
Flax and hemp	France	*South-west Court*	449
Flax weaving	XIX.	*South Gallery*	273
Flax yarn	Austria	*N.-west Transept*	472
Floating revolving light	XIII.	*Nave*	195
Floors inlaid	Switzerland	*North-west Court*	539
Flowers made of insects' wings	Brazil	*Central Avenue*	419
Flutes, wood and metal	XVI.	*North Court*	137
Food	Greece	*North-west Court*	499
Food	Mecklenburg Schwerin	*S.-west Transept*	497
Food	Prussia	*S.-west. Transept*	492
Food substances (Ceylon)	Colonies	*N.-east Transept*	395
FOREIGN STATES	. . .	*Northern Courts*	402
Forging scissors	XXXII.	*South Court*	28
Fountain temple	XXXIII.	*South Court*	100
FRANCE	F. States	*South-west Court*	426

	CLASS.	SITUATION.	PAGE
Frankfort-on-the-Maine	Zollvern.	*S.-west Transept*	495
FRENCH COLONIES	France	*South-west Court*	456
French East Indies	French Colonies	*South-west Court*	456
Fruits and vegetables (Victoria)	Colonies	*N.-east Transept*	324
Fruits, preserved	Greece	*North-west Courts*	499
Furs	XXV.	*Transept S. Court*	159
Fur, feathers, and hair	France	*South-west Court*	451
Furs (Nova Scotia)	Colonies	*N.-east Transept*	367
FURNITURE AND UPHOLSTERY, INCLUDING PAPER-HANGINGS AND PAPIER-MACHÉ	XXXIII.	*North Court*	140
Furniture	Austria	*N.-west Transept*	478
Furniture	France	*South-west Court*	453
Furniture	Hn. Towns	*S.-west Transept*	498
Furniture	Mecklenburg Schwerin	*S.-west Transept*	498
Furniture	Prussia	*S.-west Transept*	493
Furniture	Spain	*South-west Court*	529
Furniture	Switzerland	*North-west Court*	538
Fuzes, Professor Abel's	XIII.	*Gallery N. Court*	193
Gems (Tasmania)	Colonies	*N.-east Transept*	334
General cutlery	XXXII.	*South Court*	26
Geological maps	Sweden	*North-west Court*	533
Geraldine lead and copper mines	Colonies	*N.-east Transept*	296
GERMANY	F. States	*South-west Court*	457
Gidji-boryle, Gidji Jeil-Carra	Colonies	*Nave E. Transept*	298
Gidji Djmjing	Colonies	*Nave E. Transept*	298
Gidji-man-gar	Colonies	*Nave E. Transept*	298
Gidji-man-gow	Colonies	*Nave E. Transept*	298
Gilding buttons	XXXII.	*South Court*	19
Glass	Austria	*N.-west Transept*	483
Glass bottles	XXXIV.	*South Court*	55
GLASS, FOR DECORATIVE AND HOUSEHOLD PURPOSES	XXXIV.	*South Court*	41
Glass	France	*South-west Court*	455
Glass letters and shop decorations	XXXIV.	*South Court*	53
Glass	Prussia	*S.-west Transept*	493
Glass	Russia	*North-west Court*	524
Glass tiles	XXXIV.	*South Court*	54
Gloves, &c.	Austria	*N.-west Transept*	475
Gold and silver	XXXIII.	*South Court*	92
Gold and silver filligree	Egypt	*North Gallery*	425
Gold and silver ornaments (India)	Colonies	*N.-east Transept*	393
Gold	Brazil	*Central Avenue*	415

	CLASS.	SITUATION.	PAGE
Gold (Canada)	Colonies	*N.-east Transept*	348
Gold (New South Wales)	Colonies	*East Dome Nave*	305
Gold (Nova Scotia)	Colonies	*N.-east Transept*	365
Goldsmiths' Company's prizes	XXXIII.	*South Court*	94
Gold (Tasmania)	Colonies	*N.-east Transept*	332
Gold (Victoria)	Colonies	*N.-east Transept*	315
Goods engine	Italy	*South Court*	503
Grains and seeds	Brazil	*Central Avenue*	417
Great circle indicator	XIII.	*Gallery N. Court*	171
Great Northern Mining Company	Colonies	*N.-east Transept*	292
Grinding machinery	France	*Western Annex*	444
Groups in silver	XXXIII.	*South Court*	101
Guadaloupe	French Colony	*South-west Court*	456
Guiana	French Colonies	*South-west Court*	456
Gun-barrels, &c.	Austria	*N.-west Transept*	465
Gunpowder	Austria	*N.-west Transept*	466
Gutta-percha potash-box	XIII.	*Gallery N. Court*	173
Harmoniums	XVI.	*North Court*	134
Hanover, Kingdom of	Zollvern.	*S.-west Transept*	495
Hats and caps	Sub-class XXVII.	*South Gallery*	275
HAYTI	F. States	*North Court*	500
Hesse, Grand Duchy	Zollvern.	*S.-west Transept*	495
Hessia, Electorate of	Zollvern.	*S.-west Transept*	495
History of the piano	XVI.	*North Court*	127
HONG-KONG	Colonies	*N.-east Transept*	393
Hops	Belgium	*Northern Courts*	406
Hops	Bavaria	*S.-west Transept*	495
HOROLOGICAL INSTRUMENTS	XV.	*Gallery N. Court*	205
Horology	France	*South-west Court*	449
Hosiery, gloves, and clothing in general	Sub-class XXVII.c.	*South Gallery*	275
Hospital and sick-room appliances	XVII.	*Gallery N. Court*	214
Ice-making machines	France	*Western Annex*	442
Idols	Ecuador	*North-east Court*	424
Illustration of elementary science	Sub-class XXIX.d.	*Central Tower*	243
Imitation jewels	Austria	*N.-west Transept*	483
INDIA	Colonies	*N.-east Transept*	386
Indian grains and pulses	Colonies	*N.-east Transept*	389
Inflated globes	Sub-class XXIX.a.	*Central Tower*	239

	CLASS.	SITUATION.	PAGE
Ink-recording telegraphs	XIII.	*Gallery N. Court*	178
Instrument employed in tabulating the traces given by the magnetographs	XIII.	*Nave*	198
IONIAN ISLANDS	COLONIES	*N.-east Transept*	400
Irish bog-oak	XXXIII.	*South Court*	124
Irish poplins	XXI.	*South Gallery*	279
Iron articles	AUSTRIA	*N.-west Transept*	480
Iron (Canada)	COLONIES	*N.-east Transept*	347
Iron and hardware (India)	COLONIES	*N.-east Transept*	392
Iron (New South Wales)	COLONIES	*East Dome Nave*	307
Iron ore	LIBERIA	*North Court*	508
Iron ores (Jamaica)	COLONIES	*N.-east Transept*	379
Iron ores	SPAIN	*South-west Court*	529
Iron and steel	XXXII.	*South Court*	1
Iron (Victoria)	COLONIES	*N.-east Transept*	321
Iron	SWEDEN	*North-west Court*	530
Isle of Réunion	FRENCH COLONY	*South-west Court*	456
Ivory carvings	NORWAY	*North-west Court*	514
Ivory statuette	XXXIII.	*South Court*	123
Jade ornaments	CHINA	*North Court*	419
JAMAICA	COLONIES	*N.-east Transept*	379
JAPAN	F. STATES	*North Court*	505
Jewellery	AUSTRIA	*N.-west Transept*	483
Kaolin (Victoria)	COLONIES	*N.-east Transept*	321
Kapunda mines	COLONIES	*N.-east Transept*	289
Kew standard barometer	XIII.	*Nave*	203
Kew standard thermometer	XIII.	*Nave*	204
Knitting-frames	FRANCE	*Western Annex*	440
Knitting-frames	ZOLLVERN.	*Western Annex*	489
Knives	XXXII.	*South Court*	27
Koh-i-Noor	XXXIII.		107
Kylis	COLONIES	*Nave, E. Transept*	299
Lace papers and valentines	Sub-class XXVIII.B.	*Gallery, N. Court*	223
Lace	AUSTRIA	*N.-west Transept*	474
Lace	BELGIUM	*Northern Courts*	413
Lace	FRANCE	*South-west Court*	451
Lace	SWITZERLAND	*North-west Court*	539
Lace	TURKEY	*North-west Court*	542
Laconian marble	GREECE	*North-west Court*	499
Lead	PORTUGAL	*Central Avenue*	518

	CLASS.	SITUATION.	PAGE
Lead ore (Canada)	COLONIES .	*N.-east Transept* .	347
Lead ores (Jamaica)	COLONIES .	*N.-east Transept* .	380
Lead, copper, and iron (Tasmania)	COLONIES .	*N.-east Transept* .	334
LEATHER, INCLUDING SADDLERY AND HARNESS	XXVI.	*Transept, S. Court*	163
Leather and saddlery (India) . .	COLONIES .	*N.-east Transept* .	392
Leather	BELGIUM .	*Northern Courts* .	414
Leather	BRAZIL .	*Central Avenue* .	418
Leather	FRANCE .	*South-west Court* .	452
Leathers	HN. TOWNS	*S.-west Transept* .	499
Lighthouse apparatus. . . .	XIII.	*Gallery, N. Court*	194
Light-room and lantern . . .	XIII.	*Nave*	194
LIBERIA	F. STATES .	*North Court* . .	507
Limoge enamels	XXXV.	*South Court* . .	83
Linen	AUSTRIA .	*N.-west Transept*.	472
Lion and tiger skins	XXV.	*Transept, S. Court*	160
Lippe, Principality of . . .	ZOLLVERN.	*S.-west Transept* .	495
Lithograph and copperplate process.	VII.	*Process Court* .	34
Lithography	Sub-class XXVIII.C.	*Gallery, N. Court*	230
Locomotives	AUSTRIA .	*Western Annex* .	464
Locomotive engines	ZOLLVERN.	*Western Annex* .	488
Looms.	SWITZERLAND	*N.-west Court* .	536
Loom	U. STATES .	*Western Annex* .	542
Luxembourg, Grand Duchy . .	ZOLLVERN.	*S.-west Transept* .	495
Machine for cutting bottle-corks .	ZOLLVERN.	*Western Annex* .	489
Machine-made tiles	XXXII.	*South Court* . .	21
Machinery and tools	DENMARK .	*North-west Court* .	421
Machinery	AUSTRIA .	*Western Annex* .	463
Machinery	BELGIUM .	*Northern Courts* .	407
Machinery	FRANCE .	*South-west Court* .	432
Machines	MECKLENBURG SCHWERIN .	*S.-west Transept* .	497
Machinery	NORWAY .	*North-west Court* .	514
Machinery	SPAIN . .	*South-west Court* .	529
Machinery	SWITZERLAND	*North-west Court* .	537
Machinery	U. STATES .	*Western Annex* .	543
Machinery	ZOLLVERN.	*Western Annex* .	490
MADAGASCAR	F. STATE .	*North Court* . .	509
Magnetometers	XIII.	*Nave*	197
Maize (Queensland)	COLONIES .	*N.-east Transept* .	342
Majolica fountain	XXXV.	*Eastern Dome* .	80
Majolica, or Raffaelle ware . . .	XXXV.	*South Court* . .	76

	CLASS.	SITUATION.	PAGE
MALTA	Colonies	*N.-east Transept*	399
Manganese (Jamaica)	Colonies	*N.-east Transept*	380
Manufacture of glass	XXXIV.	*South Court*	45
Manufacture of lead pencils	XXXII.	*Process Court*	33
Manufacture of needles	XXXII.	*Process Court*	31
Manufacture of parian	XXXV.	*South Court*	73
Manufacture of pianos	XVI.	*North Court*	129
Manufactures from hair	Sub-class XXV.c.	*Transept, S. Court*	162
Manufactures in iron	France	*South-west Court*	453
Manufactures of wool (Nova Scotia)	Colonies	*N.-east Transept*	368
Manufactures (Victoria)	Colonies	*N.-east Transept*	324
Maps	Sweden	*North-west Court*	533
Maps	Zollvern.	*S.-west Transept*	487
Marble pentelicon	Greece	*North-west Court*	499
Marqueterie tables	Italy	*South Court*	505
Marine barometer	XIII.	*Gallery, N. Court*	185
Marine galvanometer	XIII.	*Gallery, N. Court*	177
Materials for paper	Sub-class XXVIII.A.	*Gallery, N. Court*	220
Materials for pottery	XXXV.	*South Court*	60
Mathias Roth's models illustrating the movement cure	Sub-class XXIX.D.	*Central Tower*	248
MAURITIUS	Colonies	*N.-east Transept*	396
Mayotte and Nossi-Be	French Colony	*South-west Court*	456
Mediæval furniture	XXX.	*North Court*	156
MEDITERRANEAN COLONIES	Colonies	*N.-east Transept*	399
Meissen porcelain	XXXV.	*South Court*	78
Metals	Austria	*N.-west Transept*	458
Metals	Spain	*South-west Court*	530
Microscopes and microscopic preparations	XIII.	*Gallery, N. Court*	179
Microscopic illumination	XIII.	*Gallery, N. Court*	182
Microscopic writing	XIII.	*Gallery, N. Court*	181
Meerschaum pipes	Austria	*N.-west Transept*	463
Military engineering	Austria	*N.-west Transept*	465
Military engineering	Spain	*South-west Court*	529
Military hampers	XVII.	*Gallery, N. Court*	217
Mineral collection	France	*South-west Court*	427
Mineral collection	Russia	*North-west Court*	523
Mineral products	Belgium	*Northern Court*	404
Minerals	Greece	*North-west Court*	499
Minerals	Italy	*South Court*	501
Minerals (Newfoundland)	Colonies	*N.-east Transept*	369

	CLASS.	SITUATION.	PAGE
Minerals	PRUSSIA	*S.-west Transept*	492
Minerals	ROME	*South Court*	522
Minerals	SPAIN	*South-west Court*	528
Minerals	SWEDEN	*N.-west Court*	530
Minerals	U. STATES	*South-east Tower*	544
Mineral veins (Jamaica)	COLONIES	*N.-east Transept*	380
Minton's majolica	XXXV.	*South Court*	82
Missal cover	XXXIII.	*South Court*	96
Models (Nova Scotia)	COLONIES	*N.-east Transept*	368
Models	ZOLLVERN.	*S.-west Transept*	496
Mortuary monuments	XXX.	*North Court*	155
Mosaic and other tiles	XXXV.	*South Court*	64
Mosaic decorations	XXXV.	*South Court*	67
Mosaics in wood	XXX.	*North Court*	146
Moveable jet-piece for fire-engines	NORWAY	*North-west Court*	513
Mural decorations	XXX.	*North Court*	151
Music	BELGIUM	*Northern Court*	411
Musical instruments	AUSTRIA	*N.-west Transept*	469
Musical instruments	FRANCE	*South-west Court*	449
Music engraving	Sub-class XXVIII.C.	*Gallery, N. Court*	226
MUSICAL INSTRUMENTS	XVI.	*North Court*	126
Musical strings, &c.	XVI.	*North Court*	139
Muslin, muslin curtains, and embroidered muslin	XVIII.	*South Gallery*	260
Nassau, Duchy	ZOLLVERN.	*S.-west Transept*	495
Nassuck and Arcot diamonds	XXXIII.	*South Court*	113
Nardoo fruit and flour	COLONIES	*N.-east Transept*	328
NATAL	COLONIES	*N.-east Transept*	397
Natural history	Sub-class XXIX.D.	*Central Tower*	244
Natural history (Victoria)	COLONIES	*N.-east Transept*	330
Natural steel	XXXII.	*Transept & South Court*	2
Nature printing	Sub-class XXVIII.C.	*Gallery, N. Court*	225
Naval architecture	AUSTRIA	*N.-west Transept*	467
Naval architecture	HN. TOWNS	*S.-west Transept*	498
Naval architecture	PRUSSIA	*S.-west Transept*	492
Needles and fishing-tackle	XXXII.	*South Court*	14
Needle-making	XXXII.	*South Court*	14
NETHERLANDS (THE)	F. STATES	*North-west Court*	510
NEW BRUNSWICK	COLONIES	*N.-east Transept*	361
New Caledonia	FRENCH COLONY	*South-west Court*	456

	CLASS.	SITUATION.	PAGE
New Cornwall Mines	COLONIES	*N.-east Transept*	291
NEWFOUNDLAND	COLONIES	*N.-east Transept*	369
NEW SOUTH WALES	COLONIES	*East Dome, Nave*	305
Newspaper addressing machines	VII.	*Process Court*	34
NEW ZEALAND	COLONIES	*N.-east Transept*	344
Nickel (Canada)	COLONIES	*N.-east Transept*	348
Nivio	COLONIES	*Nave, E. Transept*	299
NORWAY	F. STATES	*North-west Court*	512
Nottingham lace	XXIV.	*S.-east Gallery*	264
NOVA SCOTIA	COLONIES	*N.-east Transept*	365
Oils, carbon	U. STATES	*South-east Tower*	543
Oil-colour printing	Sub-class XXVIII.C.	*Gallery, N. Court*	230
Oils (Newfoundland)	COLONIES	*N.-east Transept*	371
Oils (Vancouver)	COLONIES	*N.-east Transept*	375
Oldenburg, Grand Duchy of	ZOLLVERN.	*S.-west Transept*	496
Olive oil	AUSTRIA	*N.-west Transept*	461
Olive oil	ITALY	*South Court*	503
Onyx	XXXIII.	*South Court*	120
Opals	XXXIII.	*South Court*	118
Optical instruments	XIII.	*Gallery, N. Court*	187
Oratory in mediæval style	AUSTRIA	*N.-west Transept*	478
Ordnance	PRUSSIA	*S.-west Transept*	492
Organs and harmoniums	XVI.	*North Court*	133
Ornamental and useful glass	XXXIV.	*South Court*	51
Painted portraits	XIV.	*Central Tower*	255
Painting on porcelain	XXXV.	*South Court*	89
Palissy ware	XXXV.	*South Court*	77
Paper	SWEDEN	*North-west Court*	533
Papers, &c.	PRUSSIA	*S.-west Transept*	492
Paper bags	VII.	*Process Court*	34
Paper, card, and millboard	Sub-class XXVIII.A.	*Gallery, N. Court*	219
Paper and printing	PORTUGAL	*Central Avenue*	518
PAPER, STATIONERY, PRINTING, AND BOOKBINDING	XXVIII.	*Gallery, N. Court*	219
Papier-mâché	XXX.	*North Court*	152
Parian or statuary porcelain	XXXV.	*South Court*	71
Pastoral industry	COLONIES	*N.-east Transept*	324
Patent moulded carbon	XXXV.	*South Court*	39
Pearls	XXXIII.	*South Court*	120
Pearl oyster, the	XXXIII.	*South Court*	123
Pearl watch-dials	XV.	*Gallery, N. Court*	209
Pencils, drawing	BAVARIA	*S.-west Transept*	494

	CLASS.	SITUATION.	PAGE
Pens and penholders	XXXII.	*South Court*	23
PERU	F. STATES	*North-west Court*	517
Petroleum or rock oil	COLONIES	*N.-east Transept*	349
PHILOSOPHICAL INSTRUMENTS AND PROCESSES DEPENDING UPON THEIR USE	XIII.	*Transept, S. Court*	166
Philosophical instruments	HN. TOWNS	*S.-west Transept*	498
Philosophical instruments	FRANCE	*S.-west Court*	447
Philosophical instruments in use at Kew Observatory	XIII.	*Nave*	196
Philosophical instruments	AUSTRIA	*N.-west Transept*	467
Philosophical instruments	SWITZERLAND	*North-west Court*	537
Philosophical and mathematical instruments	XIII.	*Gallery, N. Court*	166
Photography	FRANCE	*South-west Court*	448
Photography	GREECE	*North-west Court*	499
Photography	BELGIUM	*Northern Court*	410
Photography	PRUSSIA	*S.-west Transept*	492
Photographs	MECKLENBURG SCHWERIN	*S.-west Transept*	497
Photographs in glass	XXXIV.	*South Court*	55
PHOTOGRAPHIC APPARATUS AND PHOTOGRAPHY	XIV.	*Central Tower*	246
Photographic engraving	XIV.	*Central Tower*	250
Photo-magnetographs	XIII.	*Nave*	198
Photozincography	XIV.	*Central Tower*	251
Pianos	DENMARK	*North-west Court*	422
Pianos, pianinos, and their parts	XVI.	*North Court*	126
Pin-making	XXXII.	*South Court*	15
Pin-making machines	XXXII.	*South Court*	17
Pipes	TURKEY	*North-west Court*	541
Planes	XXXII.	*South Court*	22
Plate, letterpress, and other modes of printing	Sub-class XXVIII.c.	*Gallery, N. Court*	224
Plate-glass	XXXIV.	*South Court*	58
Platinum and Iridosmine	COLONIES	*N.-east Transept*	349
Porcelain (Introductory)	XXXV.	*South Court*	75
Porcelain	XXXV.	*South Court*	81
Portraits	XIV.	*Central Tower*	253
PORTUGAL AND COLONIES	F. STATES	*Central Avenue*	517
POTTERY	AUSTRIA	*N.-west Transept*	484
Pottery	XXXV.	*South Court*	60
Pottery	FRANCE	*South-west Court*	456
Pottery	PORTUGAL	*Central Avenue*	521
Pottery	PRUSSIA	*S.-west Transept*	493
Pottery	SPAIN	*South-west Court*	530

	CLASS.	SITUATION.	PAGE
Pottery clays	XXXV.	*South Court*	61
Precious metals	RUSSIA	*North-west Court*	525
Precious metals	PRUSSIA	*S.-west. Transept*	493
Press, Eckel's	U. STATES	*South-east Tower*	542
PRINCE EDWARD'S ISLAND	COLONIES	*N.-east Transept*	369
Printing on porcelain	XXXV.	*South Court*	87
Printing	AUSTRIA	*N.-west Transept*	476
Printing and dyeing	FRANCE	*South-west Court*	451
Printing and lithography	PORTUGAL	*Central Avenue*	521
Process court	XXXII.	*South Court*	31
Prosser's machines	XXXV.	*South Court*	66
Quartz	XXXIII.	*South Court*	119
QUEENSLAND	COLONIES	*N.-east Transept*	340
Queen's service	XXXV.	*South Court*	90
Railway bridges	ZOLLVERN.	*S.-west Transept*	492
Railway carriages and appliances	FRANCE	*South-west Court*	433
Railway carriages and plant	ZOLLVERN.	*S.-west Transept*	488
Razors	XXXII.	*South Court*	27
Reformatory schools	Sub-class XXIX.B.	*Central Tower*	241
Repoussé and Niello	XXXIII.	*South Court*	99
Repoussé work	XXXIII.	*South Court*	95
Resins	COLONIES	*N.-east Transept*	329
Resins and wax	BRAZIL	*Central Avenue*	418
Ribbons	XX.	*S.-east Gallery*	271
Rifles	AUSTRIA	*N.-west Transept*	466
Rifles	SWITZERLAND	*North-west Court*	537
Rock crystal	XXXIII.	*South Court*	119
ROME	F. STATES	*South Court*	521
Roofing-slates (Canada)	COLONIES	*N.-east Transept*	352
Ropes	VENEZUELA	*North-west Court*	546
RUSSIA	F. STATES	*North-west Court*	522
Saddles	EGYPT	*North Gallery*	425
Saddlery	AUSTRIA	*N.-west Transept*	474
ST. HELENA	COLONIES	*N.-east Transept*	399
St. Mary of Madagascar	FRENCH COLONY	*South-west Court*	456
St. Pierre and Miquelon	FRENCH COLONIES	*South-west Court*	456
ST. VINCENT	COLONIES	*N.-east Transept*	383
SANDWICH ISLANDS	F. STATES	. .	527
Sapphire and ruby	XXXIII.	*South Court*	115
Sawing	XXVI.	*Transept, S. Court*	165

	CLASS.	SITUATION.	PAGE
Saxe Altenburg, Duchy	ZOLLVERN.	*S.-west Transept*	496
Saxe-Coburg Gotha	ZOLLVERN.	*S.-west Transept*	496
Saxe Meiningen, Duchy	ZOLLVERN.	*S.-west Transept*	496
Saxony, Grand Duchy	ZOLLVERN.	*S.-west Transept*	496
Saxony, Kingdom of	ZOLLVERN.	*S.-west Transept*	496
Saxon iron	XXXII.	*Transept & South Court*	11
Schwartzburg-Sandershausen	ZOLLVERN.	*S.-west Transept*	496
Schwartzburg-Rudolstadt	ZOLLVERN.	*S.-west Transept*	496
Scottish tweeds and mauds	XXI.	*South Gallery*	279
Scouring and fulling	XXI.	*South Gallery*	277
Sculpture	GREECE	*North-west Court*	498
Sculptured panels	XXX.	*North Court*	154
Scutching machine	U. STATES	*Western Annex*	542
Seal oil (Newfoundland)	COLONIES	*N.-east Transept*	371
Self-acting harpoon for killing seals	NORWAY	*North-west Court*	513
Self-recording magnetographs	XIII.	*Nave*	196
Sewing machines	XXXII.	*Process Court*	32
Sewing machine	U. STATES	*South-east Tower*	542
Sewing and embroidery cottons	XVIII.	*South Gallery*	260
Shawls and mantles	PORTUGAL	*Central Avenue*	518
Sheffield Court	XXXII.	*Transept & South Court*	3
Sheet, plate, and crown glass	XXXIV.	*South Court*	56
SIAM	F. STATES	*North Court*	528
Sidmouth stones	XXXIII.	*South Court*	124
Silent night-lamp clock	XV.	*Gallery, N. Court*	210
Silk culture	AUSTRIA	*N.-west Transept*	472
Silk	AUSTRIA	*N.-west Transept*	472
Silk	FRANCE	*South-west Court*	449
Silk	ITALY	*South Court*	504
Silk (India)	COLONIES	*N.-east Transept*	392
Silk	JAPAN	*North Court*	506
Silk manufacture	GREECE	*North-west Court*	499
Silk	RUSSIA	*North-west Court*	526
Silk	SWEDEN	*North-west Court*	533
Silk	SWITZERLAND	*North-west Court*	538
Silk	TURKEY	*North-west Court*	540
Silk	XX.	*South-east Gallery*	269
Silk (Queenland)	COLONIES	*N.-east Transept*	342
Silk fabrics	ROME	*South-Court*	522
SILK AND VELVET	XX.	*South-east Gallery*	266
Silkworms	XX.	*South-east Gallery*	267
Silver (Canada)	COLONIES	*N.-east Transept*	348
Silver fountain	XXXIII.	*South Court*	93

	CLASS	SITUATION.	PAGE
Silver filigree	TURKEY	*North-west Court*	540
Silver ores	SWEDEN	*North-west Court*	531
Silver plate	HN. TOWNS	*S.-west Transept*	497
Silver plating	XXXIII.	*South Court*	103
Silver repoussé table	XXXIII.	*South Court*	98
Silver (Victoria)	COLONIES	*N.-east Transept*	321
Silver work	NORWAY	*North-west Court*	515
"Siren" pianoforte (the)	XVI.	*North Court*	131
Skins	SWEDEN	*North-west Court*	533
Sins and furs	RUSSIA	*North-west Court*	526
SKINS, FURS, FEATHER AND HAIR	XXV.	*Transept, S. Court*	158
Smoke-consuming grate	ZOLLVERN.	*Western Annex*	491
Soap	PORTUGAL	*Central Avenue*	520
Solar eclipse, pictures of	XIII.	*Gallery, N. Court*	172
Solar camera, the	XIV.	*Central Tower*	253
Solariscopes	XIII.	*Gallery, N. Court*	193
SOUTH AUSTRALIA	COLONIES	*N.-east Transept*	287
Sound-board of pianos	XVI.	*North Court*	130
Spectacles	XIII.	*Gallery, N. Court*	187
Spinning and weaving machines	ITALY	*South Court*	503
Spinning and weaving machines	FRANCE	*Western Annex*	438
Spirameter, the	XIII.	*Gallery, N. Court*	173
Spiral-tube barometer	XIII.	*Nave*	203
Springs	XXXII.	*South Court*	22
Stained glass, and glass used in buildings and decorations	Sub-class XXXIV.A.	*South Court*	48
Stained-glass windows	Sub-class XXXIV.A.	*South Court*	48
Starches	BRAZIL	*Central Avenue*	418
Star of the South, and other diamonds	NETHERLANDS	*North-west Court*	511
Stationery	Sub-class XXVIII.B.	*Gallery, N. Court*	222
Stationery and printing	FRANCE	*South-west Court*	452
Statue of Arminius	HN. TOWNS	*S.-west Transept*	498
Steam-boiler	ITALY	*South Court*	503
Steam-engines	FRANCE	*Western Annex*	434
Steam-engine, agricultural	AUSTRIA	*Western Annex*	464
Steam-hammer	ZOLLVERN.	*Western Annex*	489
Stearine candles	BELGIUM	*Northern Courts*	406
Steel	XXXII.	*Transept & South Court*	3
Steel	FRANCE	*South-west Court*	454
Steel bells	XXXII.	*Western Annex*	13
STEEL CUTLERY AND EDGE-TOOLS	XXXII.	*South Court*	1

	CLASS.	SITUATION.	PAGE
Steel pens	Austria	*N.-west Transept*	476
Steel-testing machine	XXXII.	*South Court*	30
Strength of iron and steel	XXXII.	. .	12
Stereoscope, the	XIII.	*Gallery, N. Court*	189
Stoneware	XXXV.	*South Court*	63
Stereoscopic slides	XIV.	*Central Tower*	253
Submarine telegraph	XIII.	*Gallery, N. Court*	175
Substances used as food	France	*South-west Court*	430
Substances used for food	Portugal	*Central Avenue*	519
Sugar	Liberia	*North Court*	510
Sugar, beetroot	Sweden	*North-west Court*	533
Sugars	Brazil	*Central Avenue*	418
Sugar (Queensland)	Colonies	*N.-east Transept*	342
Sunday-school books	Sub-class XXIX.B.	*Central Tower*	240
Sundries	XIII.	*Gallery, N. Court*	190
Sundries	XVII.	*Gallery, N. Court*	216
Sundries	XXV.	*Transept, S. Court*	162
Sundries	XXXII.	*South Court*	22
Sundries	XXXIII.	*South Court*	123
SURGICAL INSTRUMENTS AND APPLIANCES	XVII.	*Gallery, N. Court*	213
Surgical instruments	Austria	*N.-west Transept*	470
Surgical instruments	Belgium	*Northern Courts*	411
Surgical instruments	Denmark	*North-west Court*	422
SWEDEN	F. States	*North-west Court*	530
Swedish iron	XXXII.	*Transept & South Court*	5
SWITZERLAND	F. States	*North-west Court*	537
Tahiti and its Dependencies	French Colonies	*South-west Court*	456
Tallow	Austria	*N.-west Transept*	462
TAPESTRY, LACE, AND EMBROIDERY	XXIV.	*South-east Gallery*	263
Tarata boiling springs	Colonies	*N.-east Transept*	345
TASMANIA	Colonies	*N.-east Transept*	332
Tea	Brazil	*Central Avenue*	47
Teaching the blind	Sub-class XXIX.B.	*Central Tower*	242
Telegraph cables	XIII.	*Gallery, N. Court*	176
Telegraphs, electric	Austria	*N.-west Transept*	468
Telescopes, &c.	XIII.	*Gallery, N. Court*	190
Terra-cotta	XXXV.	*South Court*	63
Textile fabrics	Belgium	*Northern Courts*	411
Textile fabrics (India)	Colonies	*N.-east Transept*	391

	CLASS.	SITUATION.	PAGE
Textile fabrics	PRUSSIA	*S.-west. Transept*	493
Textile fabrics	SWEDEN	*North-west Court*	534
Textile manufactures	SWITZERLAND	*North-west Court*	539
Thermometers and barometers	XIII.	*Gallery, N. Court*	183
Timber	LIBERIA	*North Court*	509
Timber (New Brunswick)	COLONIES	*N.-east Transept*	361
Tinning of pins	XXXII.	*South Court*	16
Tin ore (Victoria)	COLONIES	*N.-east Transept*	321
Tobacco	AUSTRIA	*N.-west Transept*	460
Tobacco	BELGIUM	*Northern Courts*	406
Tobacco and snuff	BRAZIL	*Central Avenue*	418
Tobacco (Mauritius)	COLONIES	*N.-east Transept*	396
Tobacco	SWEDEN	*North-west Court*	534
TOILET TRAVELLING AND MISCELLANEOUS ARTICLES	XXXVI.	*Gallery, N. Court*	282
Tonic-sol-fa method of teaching to sing	Sub-class XXIX.D.	*Central Tower*	245
Topaz (Victoria)	COLONIES	*N.-east Transept*	323
Tortoise-shell (Bahamas)	COLONIES	*N.-east Transept*	385
Toys	JAPAN	*North Court*	506
Toys and games	Sub-class XXIX.C.	*Central Tower*	243
Transposition cornet	XVI.	*North Court*	136
Transit instrument	XIII.	*Gallery, N. Court*	192
TRINIDAD	COLONIES	*N.-east Transept*	377
Trunks and travelling apparatus	Sub-class XXXVI.B.	*Gallery, N. Court*	283
Trusses and belts	XVII.	*Gallery, N. Court*	214
Tube cutter	XXXII.	*South Court*	29
"Tubular" pianoforte, the	XVI.	*North Court*	132
TURKEY	F. STATES	*North-west Court*	539
Type-composing machine	. .	*Process Court*	40
Unifilar magnetometer	XIII.	*Nave*	199
UNITED STATES	F. STATES	*South-east Tower*	541
URUGUAY	F. STATES	*N. Central Court*	543
Value of diamonds	XXXIII.	*South Court*	114
VANCOUVER	COLONIES	*N.-east Transept*	374
Various tools	XXXII.	*South Court*	29
Vegetable products of South Australia	COLONIES	*N.-east Transept*	293
Vegetable produce	NORWAY	*North-west Court*	516
Vegetable substances	SPAIN	*South-west Court*	520
Veils	TURKEY	*North-west Court*	549
Velvet	XX.	*S.-east Gallery*	170

	CLASS.	SITUATION.	PAGE
Velvet weaving	VII.	*Process Court*	37
Venetian carpets	XXII.	*Gallery Walls*	281
Venetian glass	XXXIV.	*South Court*	42
Venetian looking-glass	XXX.	*North Court*	144
VENEZUELA	F. STATES	*North-west Court*	544
Ventilating apparatus	FRANCE	*South-west Court*	429
Verde antique	GREECE	*North-west Court*	500
VICTORIA	COLONIES	*N.-east Transept*	314
Violins, wind instruments and drums	XVI.	*North Court*	135
Wallaroo Mines	COLONIES	*N.-east Transept*	290
Walnut-wood cabinet	XXX.	*North Court*	150
Waldeck	ZOLLVERN.	*S.-west Transept*	496
Watch jewels and gauges	XV.	*Gallery, N. Court*	210
Watchman's detector	XV.	*Gallery, N. Court*	207
Watches	SWEDEN	*North-west Court*	534
Watches	SWITZERLAND	*North-west Court*	537
Wedgewood ware	XXXV.	*South Court*	84
WESTERN AFRICA	F. STATES	*Northern Courts*	402
WESTERN AUSTRALIA	COLONIES	*N.-east Transept*	295
West Coast of Africa	FRENCH COLONIES	*South-west Court*	456
West of England cloths, the	XXI.	*South Gallery*	278
Wheal Arrino	COLONIES	*N.-east Transept*	296
Wheal Fortune Copper Mine	COLONIES	*N.-east Transept*	295
Wheat (South Australia)	COLONIES	*N.-east Transept*	293
Wheat and grain	SWEDEN	*North-west Court*	531
Wheat	URUGUAY	*N. Central Court*	543
Whet and grinding stones	BELGIUM	*Northern Courts*	405
Wilgi	COLONIES	*Nave, E. Transept*	297
Window-glass	XXXIV.	*South Court*	43
Wines	ITALY	*South Court*	501
Wines	PORTUGAL	*Central Avenue*	518
Wines	RUSSIA	*North-west Court*	526
Wine (South Australia)	COLONIES	*N.-east Transept*	294
Wines and liqueurs	SWITZERLAND	*North-west Court*	538
Wines (Western Australia)	COLONIES	*Nave, E. Transept*	302
Wires for crinoline	XXXII.	*South Court*	22
Woods	BRAZIL	*Central Avenue*	417
Woods	ITALY	*South Court*	502
Woods	SWEDEN	*N.-west Court*	532
Woods (Canada)	COLONIES	*N.-east Transept*	353
Woods (Nova Scotia)	COLONIES	*N.-east Transept*	367
Wood (New South Wales)	COLONIES	*East Dome, Nave*	311
Woods (Tasmania)	COLONIES	*N.-east Transept*	335

	CLASS.	SITUATION.	PAGE
Woods (Victoria)	COLONIES	*N.-east Transept*	328
Woods (Western Australia)	COLONIES	*Nave, E. Transept*	300
Wood-carvings	XXX.	*North Court*	148
Wood-carving	DENMARK	*N.-west Court*	423
Wood-turning	XXX.	*North Court*	142
Wood-working machines	FRANCE	*Western Annex*	438
Wool	AUSTRIA	*N.-west Transept*	473
Wool	MECKLENBURG SCHWERIN	*S.-west Transept*	497
Wool	SWEDEN	*North-west Court*	533
Wool (Queensland)	COLONIES	*N.-east Transept*	342
WOOLLEN AND WORSTED, INCLUDING MIXED FABRICS	XXI.	*South Gallery*	276
Woollens	XXI.	*South Gallery*	277
Woollens	FRANCE	*South-west Court*	450
Working models	XIII.	*Gallery, N. Court*	191
Works in precious metals	FRANCE	*South-west Court*	454
WORKS IN PRECIOUS METALS, AND THEIR IMITATIONS, AND JEWELLERY	XXXIII.	*South Court*	92
WOVEN, SPUN, FELTED, AND LAID FABRICS, AS SPECIMENS OF PRINTING OR DYEING	XXIII.	*S.-east Gallery*	257
Writing-papers	Sub-class XXVIII.A.	*Gallery, N. Court*	221
Würtemburg, Kingdom of	ZOLLVERN.	*S.-west Transept*	496
Yorkshire cloths	XXI.	*South Gallery*	278
Zinc ores (Jamaica)	COLONIES	*N.-east Transept*	380
Zollverein	GERMANY	*S.-west Transept*	487

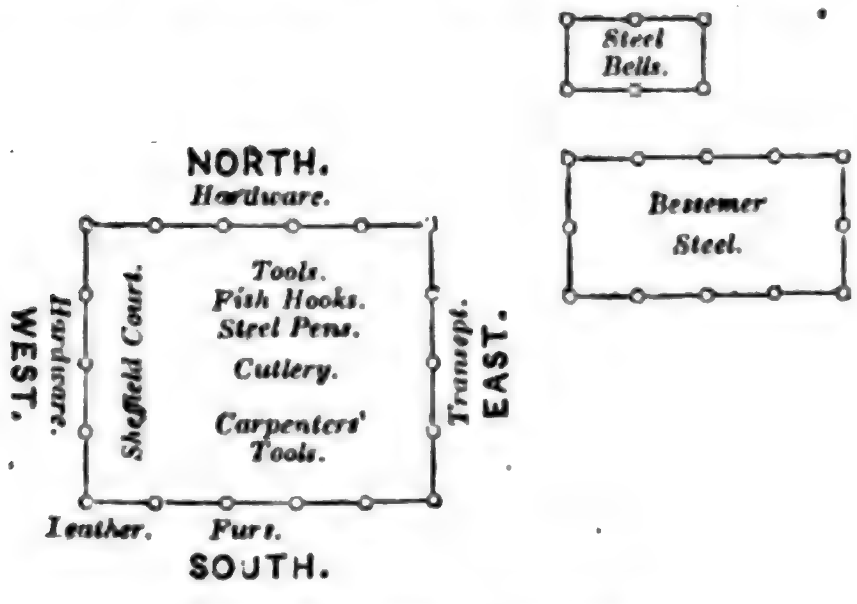
INTERNATIONAL EXHIBITION, 1862.

CLASS XXXII.—STEEL CUTLERY AND EDGE TOOLS.

Number of Exhibitors, 126.

SITUATION OF CLASS.—*One of the South Courts, and part of East Transept. The small court devoted to Steel goods is bounded on the North and West by Class XXXI., Iron and Hardware; and on the South by Class XXVI., Leather; and Class XXV., Furs.*

Position of Groups.—The Court on the Western side of the Eastern Transept is devoted to Cutlery, Tools, and Steel goods generally. In the Transept is the collection of Bessemer's steel, and to the north of it are the steel bells of Naylor, Vickers and Co.



IRON AND STEEL.

Exhibitors.—Acadian Charcoal Iron Co. (6425), H. Bessemer (6427), J. Brown and Co. (6430), C. Cammell and Co. (6432), Naylor, Vickers and Co (6448), W. and J. Page (6450), Shortridge, Howell and Co. (6456), Smith and Houghton (6458), J. Spencer and Sons (6460).

The conversion of iron into steel is scarcely a subject for discussion in a Handbook, although there is much that is curious in the known facts, and still more that solicits careful inquiry.

Steel, in general terms, may be stated to be a definite compound of carbon and iron. It has been thought by some that nitrogen performs an important part in the conversion of iron into steel, and certainly there are some interesting results recorded as having been obtained by treating pig-iron with cyanogen—a compound of nitrogen and carbon,—but probably in this case the carbon is still the converting agent.

Pig-iron contains from 4 per cent. to 5 per cent. of carbon: if this iron is treated in a suitable furnace until the carbon is reduced to about 1 per cent. we have Steel.

Iron containing as little as 2·3 per cent. of carbon still retains the property of cast iron: with 2 per cent. of carbon iron is not forgeable, and scarcely so if it contains only 1·9 per cent. With this quantity of carbon it is Steel (cast steel), though not of the weldable kind.

Bar iron—malleable iron, according to the analyses of Guy-Lussac, Karsten, and others—contains the following amounts of carbon:—

Best bar iron, from Sweden - -	0·293
Soft bar iron (*Karsten*) - - -	0·200
Hard „ „ - - -	0·500
Swabian refined iron - - - -	0·318
Bar iron, from Champagne - -	0·159

Thus bar iron may be converted into steel by being heated in contact with carbon, when it absorbs the requisite quantity.

Steel may be classed into three kinds.

1. *Natural steel*, manufactured from pig-iron direct.
2. *Cemented* or *Converted steel*, which is produced by the carbonization of wrought iron.
3. Cast steel, which is produced by the fusion of either natural or cemented steel, but principally the latter.

For a long period the various kinds of iron which were used for the manufacture of steel were imported from Sweden, Norway, and Russia. All these varieties of iron are manufactured from very pure iron ores smelted with charcoal. There is but one firm in this country smelting iron with charcoal: this is the firm of Harrison, Ainslie, and Co., of Ulverstone, who exhibit in Class I. They have three furnaces in the counties of Lancashire, and Cumberland, and one in Scotland, all of them being worked with charcoal only, the ore employed being the hematite of Lancashire. Their iron is highly prized for the manufacture of wire, and the more important articles made in malleable iron.

Of late, the high price of Swedish and other steel iron has led our ironmasters to turn their attention to our own manufactures, so to improve our pig-iron as to render it fit for the production of steel of fairly good quality.

STEEL.

THE SHEFFIELD COURT.

The causes that have fixed the seats of our principal manufactures would form an interesting subject of inquiry. In many instances the particular minerals or earths of a district may determine its manufactures. But this is not invariably the case, for modern systems of transport have more equally balanced the facilities of all localities. Where, however, a trade has been established for centuries, its origin may be generally traced to some peculiarity of the district. Thus we find the manufacture of iron first takes place in those situations where iron-stone and fuel for smelting are in convenient proximity. This, I have no doubt, was the case in the neighbourhood of Sheffield. There are places within a few miles of that town where Romans have left evidences of their industry and their arts. To the iron, coal, clay, stone, and water-power of Sheffield and its neighbourhood, we may clearly trace the origin of its metallic productions. But it is not the object of the present paper to enter into the history of those manufactures, however interesting such a subject might be. The extent to which they are carried at the present time indicates, in a marked degree, the progress of civilization and refinement. The value of our exports in cutlery and hardware shows that they form a considerable portion of our nationa industry. As, however, it is asserted that the manufactures of articles from steel is on the decline in this country, and that, as a nation, we are already behind several continental nations, it becomes us calmly to see how far these statements are capable of proof, and to estimate what our capabilities really are. I have no hesitation in saying that the best class of cutlery is of a superior character altogether to the productions of any previous time, and for these reasons :—We have material as good as ever to work upon; we have workmen as skilful as the artizans of any preceding age; we have better designs to work from, and the chemistry of metals is better understood, though still, perhaps, not sufficiently apppreciated.

In order to render the subject clear, it may be desirable to explain that by the term cutlery, I mean any article manufactured from iron or steel, or both, for cutting purposes. I am aware that such a definition would exclude many articles, which, as well as knives and razors, require good materials and nicety of workmanship. It will tend to simplicity to exclude from our minds everything but the essential property of the article. Thus, in speaking of a knife, I simply mean the blade, when not otherwise expressed. Thus the blade, if merely fastened to a piece of wood, is as much a knife as if connected with a handle of pearl. If we consider the properties of a good blade, they will be found to be hardness, or temper, elasticity, and capability of "holding an edge" equal to the performance of the proper work for which it is designed. Many people, however, have curious ideas of the capability of a blade, and would use a penknife as they would a bill-hook, and expect in a razor the property of an oyster-knife. We must here suppose that each article is used for its proper purpose.

I am not aware how far the proper angle of edges may have been investigated, but I think the cutting angle of a good razor or penknife will be from 15° to 25°. In scissors, however, there is a great difference, as the cutting is a combination of perpendicular and lateral pressure. The cutting angle is that which will give the greatest strength compatible with sharpness. This will be an angle of about 80°, which affords a sufficient strength to prevent "snipping," and sufficient sharpness to answer the purpose for which it is intended. Should the edge exceed a right angle, it would lose sharpness according to the increase in the angle. For "edge tools," or joiners' tools, no fixed rule can be given. From the variety of instruments, and their equally varied uses, it is impossible to adhere to any given rule.

It has been affirmed that we possess as good materials as ever for making cutlery, namely, steel; and I am assured by experienced steel refiners, that, when required and paid for, steel can be made of the greatest excellence, though much of a bad quality is manufactured for the production of cheap goods.

In the manufacture of common steel, particularly that for railway springs, a very large quantity of steel-iron is produced from English materials. Of this kind of iron, not less than 15,000 tons are annually consumed in Sheffield for springs and common hardware. This iron is produced from the coke-made pig-iron, by puddling, during which process substances are added, which, although not always the same, yet produce nearly similar effects.

At present we are largely indebted to Sweden for our supply of suitable iron for the manufacture of steel.

The following is a statement of our importations since 1845:—

Year.	Tons.	Year.	Tons.
1845	18,607	1852	23,817
1846	30,840	1853	23,540
1847	28,264	1854	24,436
1848	20,438	1858	25,464
1849	26,605	1859	42,713
1850	28,096	1860	54,061
1851	35,467		

With very trifling exceptions, the whole of this iron is used for steel. The above figures give an average importation for the first ten years of 26,011 tons, and above 34,000 for the last three, to which we must add the steel now made in England from our own iron : we may therefore estimate the weight of steel manufactured in England at from 45,000 to 50,000 tons, annually.

THE BESSEMER STEEL.

When engaged upon the production of the new "Dictionary of Arts, Manufactures, and Mines"—based upon the former productions of Dr. Ure—Mr. Bessemer obligingly forwarded to me a description of his process. This is so clear, and the discovery is of so important a character, that I quote the description without curtailment.

"The want of success which attended some of the early experiments was erroneously attributed, by some persons, to the 'burning' of the metal, and by others, to the absence of cinder, and to the crystalline condition of cast metal. It was almost needless to say that neither of the causes assigned had anything to do with the failure of the process, in those cases where failure had occurred. Chemical investigation soon pointed out the real source of difficulty. It was found, that although the metal could be wholly decarbonized, and the silicium be removed, the quantity of sulphur and of phosphorus was but little affected; and as different samples were carefully analysed, it was ascertained that red-shortness was always produced by sulphur, when present, to the extent of one-tenth per cent., and that cold-shortness resulted from the presence of a like quantity of phosphorus; it therefore became necessary to remove those substances. Steam and pure hydrogen gas were tried, with more or less success, in the removal of sulphur ; and various flukes, composed chiefly of silicates of the oxide of iron and manganese, were brought in contact with the fluid metal during the process, and the quantity of phosphorus was thereby reduced. Thus, many months were consumed in laborious and expensive experiments ; consecutive steps in advance were made, and many valuable facts were elicited. The successful working of some of the higher qualities of pig-iron caused a total change in the process, to which the efforts of Messrs. Bessemer and Longsdon were directed. It was determined to import some of the best Swedish pig-iron, from which steel of excellent quality was made, and tried for almost all the uses for which steel of the highest class was employed. It was then decided to discontinue, for a time, all further experiments, and to erect steel works at Sheffield for the express purpose of fully developing and working the new process commercially, and thus to remove the erroneous impressions so generally entertained in reference to the Bessemer process.

"In manufacturing tool steel of the highest quality, it was found preferable, for several reasons, to use the best Swedish pig-iron, and, when converted into steel by the Bessemer process, to pour the fluid steel into water, and afterwards to remelt the shotted metal in a crucible, as at present practised in making blister-steel, whereby the small ingots required for this particular article were more perfectly and more readily made.

"It was satisfactory to know that there existed in this country vast, and apparently inexhaustible, beds of the purest ores fitted for the process. Of the hematite alone, 970,000 tons were raised annually, and this quantity might be doubled or trebled, whenever a demand arose. It was from the hematite pig-iron, made at the Workington Ironworks, that most of the iron and steel was made. About 1 ton 13 cwt. of ore, costing 10s. per ton, would yield 1 ton of pig metal, with 60 per cent. less lime, and 20 per cent. less fuel, than were generally consumed when working inferior ores; while the furnaces using this ore alone yielded from 220 tons to 240 tons per week, instead of, say, 160 tons to 180 tons per week, when working with common iron-stone. The Cleator Moor, the Weardale, and the Forest of Dean Ironworks also produced an excellent metal for this purpose.

"The form of converting vessel which had been found most suitable somewhat resembled the glass retort used by chemists for distillation. It was mounted on axes, and was lined with 'ganister,' or road drift, which lasted during the conversion of thirty or forty charges of steel, and was then quickly and cheaply repaired, or renewed. The vessel was brought into an inclined position, to receive the charge of crude iron, during which time the tuyères were above the surface of the metal. As soon as the whole charge was run in, the vessel was moved on its axes, so as to bring the tuyères below the level of the metal, when the process was at once brought into full activity, and twenty small, though powerful, jets of air sprang upwards through the fluid mass; the air, expanding in volume, divided itself into globules, or burst violently upwards, carrying with it a large quantity of the fluid metal, which again fell back into the boiling mass below. The oxygen of the air appeared, in this process, first to produce the combustion of the carbon contained in the iron, and at the same time to oxidise the silicium, producing silicic acid, which, uniting with the oxide of iron, obtained by the combustion of a small quantity of metallic iron, thus produced a fluid silicate of the oxide of iron, or 'cinder,' which was retained in the vessel and assisted in purifying the metal. The increase of temperature which the metal underwent, and which seemed so disproportionate to the quantity of carbon and iron consumed, was doubtless owing to the favourable circumstances under which combustion took place. There was no intercepting material to absorb the heat generated, and to prevent its being taken up by the metal; for heat was evolved at thousands of points, distributed throughout the fluid, and when the metal boiled, the whole mass rose far above its natural level, forming a sort of spongy froth, with an intensely vivid combustion going on in every one of its numberless, ever-changing cavities. Thus by the mere action of the blast, a temperature was attained, in the largest masses of metal, in ten or twelve minutes, that whole days of exposure in the most powerful furnace would fail to produce.

"The amount of decarbonisation of the metal was regulated, with great accuracy, by a meter, which indicated on a dial the number of cubit feet of air that had passed through the metal; so that steel of any quality or temper could be obtained with the greatest certainty. As soon as the metal had reached the desired point (as indicated by the dial), the workmen moved the vessel, so as to pour out the fluid malleable iron or steel into a founder's ladle, which was attached to the arm of a hydraulic crane, so as to be brought readily over the moulds. The ladle was provided with a fire-clay plug at the bottom, the raising of which, by a suitable lever, allowed the fluid metal to descend in a clear vertical stream into the moulds. When the first mould was filled, the plug valve was depressed, and the metal was prevented from flowing until the casting ladle was moved over the next mould, when the raising of the plug allowed this to be filled in a similar manner, and so on until all the moulds were filled.

"The casting of large masses of a perfectly homogeneous malleable metal into any desired form rendered unnecessary the tedious, expensive, and uncertain operation of welding now employed wherever large masses were required. The extreme toughness and extensibility of the Bessemer iron was proved by the bending of cold bars of iron 3 in. square, under the hammer, into a close fold, without the smallest perceptible rupture of the metal at any part; the bar being extended on the outside of the bend from 12 in. to 16¾ in., and being compressed on the inside from 12 in. to 7¼ in., making a difference in length of 9½ in., between what, before bending, were the two parallel sides of a bar 3 in. square. An iron cable, consisting of four strands of round iron 1½ in. diameter, was so closely twisted, while cold, as to cause the strands at the point of contact to be permanently imbedded into each other. Each of these strands had elongated 12½ in. in a length of 4 ft., and had diminished 1-10th of an inch in diameter, throughout their whole length. Steel bars, 2 in. square, and 2 ft. 6 in. in length, were twisted cold into a spiral, the angles of which were about 45°; and some round steel bars 2 in. in diameter were bent cold, under the hammer, into the form of an ordinary horse-shoe magnet, the outside of the bend measuring 5 in. more than the inside.

"The steel and iron boiler plates, left without shearing, and with their ends bent over cold, afforded ample evidence of the extreme tenacity and toughness of the metal; while the clear even surface of railway axles and pieces of malleable iron ordnance were examples of the perfect freedom from cracks, flaws, or hard veins which forms so distinguishing a characteristic of the new metal. The tensile strength of this metal was not less remarkable, as the several samples of steel tested in the proving machine at Woolwich Arsenal, bore, according to the reports of Colonel Eardley Wilmot, R.A., a strain varying from 150,000 lbs. to 160,900 lbs. on the square inch, and four samples of iron boiler plate from 68,314 lbs. to 73,100 lbs. while according to the published experiments of Mr. W. Fairbairn, Staffordshire plates bore a mean strain of 45,000 lbs.; and Low Moor and Bowling plates a mean of 57,120 lbs. per square inch.

"There was also another fact of great importance in a commercial point of view. In the manufacture of plates for boilers and for ship-building, the cost of production increased considerably with the increase of weight in the plate; for instance, the Low Moor Iron Company demanded 22*l.* per ton for plates weighing 2½ cwt. each; but if the weight exceeded 5 cwt., then the price rose from 22*l.* to 37*l.* per ton. Now with cast ingots, such as the one exhibited, and from which the sample plates were made, it was less troublesome, less expensive, and less wasteful of material, to make plates weighing from 10 cwt. to 20 cwt., than to produce smaller ones; and, indeed, there could be but little doubt that large plates would eventually be made in preference, and that those who wanted small plates would have to cut them from the large ones. A moment's reflection would, therefore, show the great economy of the new process in this respect; and when it was remembered that every riveted joint in a plate reduced the ultimate strength of each 100 lb. to 70 lb., the great value of long plates for girders and for ship-building would be fully appreciated.

"It would be interesting to those who were watching the advancement of the new process, to know that it was already rapidly extending itself over Europe. The firm of Daniel Elfstrand and Co., of Edsken, who were the pioneers in

Sweden, had now made several hundred tons of excellent steel by the Bessemer process. Another large manufactory had since been started in their immediate neighbourhood, and three other companies were also making arrangements to use the process. The authorities in Sweden had fully investigated the whole process, and had pronounced in favour of it. Large steel circular saw-plates were made by Mr. Göranson, of Gefle, in Sweden, the ingot being cast direct from the fluid metal within fifteen minutes of its leaving the blast furnace. In France the process had been for some time carried on by the old established firm of James Jackson and Son, at their steel-works near Bordeaux. This firm was about to manufacture puddled steel on a large scale. They had already got a puddling furnace erected and in active operation, when their attention was directed to the Bessemer process, the apparatus for which was put up at their works last year; and they were now extending their field of operations, by putting up more powerful apparatus at the blast furnaces in the Landes. There were also four other blast furnaces in the South of France in course of erection, for the express purpose of carying out the new process.

"The irons of Algeria and Saxony had produced steel of the highest quality.

"Belgium was not much behind her neighbours; the process was now being carried into operation at Liège, where excellent steel had been made from the native coke iron; while in Sardinia preparations were also being made for working the system. Professor Müller, of Vienna, and M. Dumas, from Paris, had visited Sweden, to inspect and report on the working of the new system in that country.

"That the process admitted of further improvement, and of a vast extension beyond its present limits, the author had no doubt; but those steps in advance would, he imagined, result chiefly from the experience gained in the daily commercial working of the process, and would most probably be the contributions of the many practical men who might be engaged in carrying on the manufacture of iron and steel by this system."

The following information is of interest :—

Comparative tensile strength of various kinds of Iron and Steel, in lbs. per square inch.

	lbs.	
Ordinary cast iron (which varies considerably) may be taken at	18,656	Templeton.
Swedish cast iron, used for ordnance	33,000	Woolwich Arsenal.
"Bessemer iron" in its cast, unhammered state, mean of 5 trials	41,242	"

Wrought Iron Plates; mean breaking weight with, and across, the fibre.

	lbs.	
Yorkshire plates; best	59,584	Fairbairn.
" ordinary	54,656	"
Derbyshire " "	45,136	"
Shropshire " "	50,176	"
Staffordshire " "	45,472	"
Mean of 4 trials of soft iron plates made by the "Bessemer" process	68,319	Woolwich Arsenal.
Boiler plates, made of very soft cast steel (approaching in quality to iron), made by the "Bessemer process"	110,000	Trials at Manchester.

Iron bars, hammered or rolled.

	lbs.	
English bar iron	55,872	Templeton.
" "	56,000	Rennie's Tables.
Swedish "	72,000	" "
" "	72,064	Templeton.
"Bessemer iron," mean of 8 trials	72,643	Woolwich Arsenal.
" maximum	82,110	"

Steel.

	lbs.	
Cast steel, made by the "Bessemer process" in its unhammered state; mean of 8 trials	63,022	"
Sheffield cast steel	130,000	Rennie's Tables.
Cast steel, made by "Krupp" of Essen	127,320	Woolwich Arsenal.
	lbs.	
Cast steel, made by "Captain Uchatius"	91,955	
Cast steel, made of Nova Scotia iron by the ordinary process	128,043	
"Bessemer steel," mean of 7 trials	152,911	
" " maximum	162,970	

STEEL BELLS.

Exhibitors.—Naylor, Vickers and Co. (6448).

The principal advantages of cast steel bells, as compared with bronze bells hitherto in use, are as follows: Cast steel bells cost forty per cent. less per lb. than bronze bells. Bells of the same diameter and depth of tone are forty per cent. lighter in steel than in bronze. The price of cast steel bells, therefore, is only one third that of bronze bells. Cast steel bells have a very pure melodious sound, fully equal to the best bronze; and their vibrations being more powerful, the sound penetrates to a greater distance. Cast steel is a much stronger material than bronze, and on this account these bells are less liable to crack, and thus they last longer than bronze bells. A given key, it is said, can be produced with greater accuracy in cast steel than in bronze, but we do not know upon what evidence this statement is made. Every bell is warranted for one year, by this firm, not to break with proper usage in any climate, or under any atmospheric changes.

COMPARATIVE TABLE OF THE WEIGHTS AND PRICES OF CAST STEEL BELLS.

CAST STEEL BELLS.							BRONZE BELLS.						
Diameter.	Weight.	Price per lb.		Cost of each Bell.			Diameter.	Weight.	Average Price per lb.		Cost of each Bell.		
Inches.	lbs.	s.	d.	£	s.	d.	Inches.	lbs.	s.	d.	£	s.	d.
18	100	0	11	4	11	8	18	162	1	5	11	9	6
24	200	0	11	9	3	4	24	369	,,		26	2	9
30	430	0	11	19	14	2	30	706	,,		50	0	2
36	740	0	10	30	16	8	36	1152	,,		81	12	0
48	1600	0	10	66	13	4	48	2500	,,		177	1	8
72	4640	0	10	198	6	8	72	6600	,,		467	10	0

Naylor, Vickers, and Co. exhibit, in the Western Transept, a peal of eight cast steel bells,—tenor, 48 inches diameter, and total weight of the peal, 70 cwt; a cast steel bell, 90 inches diameter, and cast steel hemispherical bells, or gongs.

In the same collection will be found many very fine examples of works in cast steel. The most remarkable being cast steel tyres, without a weld; rolled from a solid ingot. Disc wheels or railways; corrugated disc wheels, &c., which are solid castings without mechanical compression. Cast steel double crank, axle crank and other marine shafts, &c., all forged out of solid ingots.

Casting of steel from crucibles is a picturesque process, and is particularly so when it is cast in large masses; the number of workmen in the dark foundry brought into strong relief by the intense light of the fluid metal, and the myriads of sparks thrown from the metal during the pouring, render the scene animated and picturesque in a very high degree. See Class I.

EYES AND HOOKS, PINS, BUTTONS, AND STUDS.

Exhibitors.—**T. Bullock and Son (6006), Elizabeth Ellis (6053), J. Frearson (6067), Hammond, Turner and Son (6093), E. Iles (6112), Iliffe and Player Brothers (6113), J. James and Sons (6118), Pigott and Co. (6181), Sarah A. Rowley (6207), J. W. Scott (6210), C. J. Weldon (6245).**

NEEDLES, AND FISHING TACKLE.

Exhibitors.—**S. Allcock and Co (6426), W. Boulton and Son (6428), G. Goodman (6435), P. Hutchinson and Son (6439), Kirby, Beard, and Co. (6440), W. Knights and Co. (6441), H. Lewis and Son (6442), H. Milward and Sons (6443), J. Rowell (6454), J. W. Smith (6457), S. Thomas and Sons (6461), G. Townsend and Co. (6462), R. Turner and Co. (6463), G. L. Turney (6464), H. Walker (6468), Hadfield and Shipman (6436).**

Needle-making.—The difficulties in manufacturing these tiny particles are extraordinary, and sufficient almost to deter any one acquainted with them from trying. From this cause immense numbers of imperfect needles find their way into the market, and large makers will always maintain their stand as they are better able to incur the losses, and also to export the goods to those markets where civilization is only just dawning, and where, always, the lower qualities of goods are used. The processes, it is true, are very simple, but they are very numerous, and it rarely happens that all are accomplished satisfactorily; although thirty-nine might be perfected that would count as nothing with the sempstresses, if the remaining one process were badly done. For instance, should the eye be weak, and break, the head be badly rounded, and hurt the finger, the eye cut the thread, the head or eye be square or of an ugly shape, the needle be badly scoured and pass with difficulty through the work, the temper be too hard or too soft, the points break or bend, be too tapered, or too blunt, the fault would be at once discovered by the consumer, and the make of the needles condemned.

Needles are manufactured from steel wire. The wire is cut into lengths sufficient to make two needles; these are collected into bundles, and straightened by a peculiar process; the grinder takes a number of these pieces in his hand, and causing them to rotate on a grindstone, points them; he next reverses the ends and effects the same result. They are then cut in two, flattened on the end, and eye-punched, either by children, or machinery; the roughness is removed, and the eye smoothed by filing. The process can be examined in the needle-making being carried on during the day by a very nice small machine. They are then tempered in quantities, and polished by being gathered together and made to traverse a horizontal hearth or table, and some abrasive substance lubricated with oil being introduced amongst them: scouring, winnowing, and sorting then follows. (See PROCESS COURT in this Part.) A very full description of this most interesting manufacture will be found in the Author's Edition of "Ure's Dictionary of Manufactures."

Pin-making.—Some improvements have been made in pin-making. The heads are now in general solid, not formed by two revolutions of wire as formerly. By this, several stages in the operation of making a pin are dispensed with, in which there are no less than twelve distinct operations.

Straightening the wire.—The wire, as obtained from the drawing-frame is wound about a bobbin or barrel, about

6 inches diameter, which gives it a curvature that must be removed. The workman pulls the wire with pincers through the straightening machine, to the length of about 30 feet, at a running draught; and after he cuts that off, he returns for as much more; he can thus finish 600 fathoms in the hour. He next cuts these long pieces into lengths of three or four pins. A day's work of one man amounts to 18,000, or 20,000 dozen of pin-lengths.

Pointing is executed on two iron or steel grindstones, by two workmen, one of whom roughens down, and the other finishes. Thirty or forty of the pin wires are applied to the grindstone at once, arranged in one plane, between the two forefingers and thumbs of both hands, which dexterously give them a rotatory movement.

Cutting these wires into pin-lengths.—This is done by an adjusted chisel.

Twisting of the wire for the pin-heads.—These are made of a much finer wire coiled into a compact spiral, round a wire of the size of the pins, by means of a small lathe constructed for the purpose. The head is now generally raised by a punch out of the solid wire of the pin.

Stamping or shaping the heads.—This is done by the blow of a small ram, raised by means of a pedal lever and a cord. The pin-heads are also fixed on by the same operative, who makes about 1500 pins in the hour, or from 12,000 to 15,000 per diem, exclusive of one-thirteenth, which is always deducted for waste in this department, as well as in the rest of the manufacture. Cast heads, of an alloy of tin and antimony, were introduced by patent, but never came into general use.

Yellowing or cleaning the pins is effected by boiling them for half an hour in sour beer, wine lees, or solution of tartar; after which they are washed.

Whitening or tinning.—A stratum of about 6 lbs. of pins is laid in a copper pan, then a stratum of about 7 lbs. to 8 lbs. of grain tin; and so alternately till the vessel be filled; a pipe being left inserted at one side, to permit the introduction of water slowly at the bottom, without deranging the contents.

When the pipe is withdrawn, its space is filled up with grain tin. The vessel being now set on the fire, and the water becoming hot, its surface is sprinkled with four ounces of cream of tartar; after which it is allowed to boil for an hour. The pins and tin grains are, lastly, separated by a kind of cullender.

Washing the pins in pure water follows this.

Drying and polishing them in a leather sack filled with coarse bran, which is agitated to and fro by two men.

Winnowing by fanners is the next operation.

Pricking the papers for receiving the pins, and *papering*, or fixing them in the paper, is the last operation. This is done by children, who acquire the habit of putting up 36,000 per day.

The above is an outline of the mode of manufacturing pins by hand labour, but several beautiful inventions have been employed to make them entirely, or in a great measure, by machinery. The following outline will give the reader an idea of the structure of Mr. L. W. Wright's ingenious machine for pin-making.

The rotation of a principal shaft mounted with several cams gives motion to various sliders, levers, and wheels, which work the different parts. A slider pushes pincers forwards, which draw wire from a reel at every rotation of the shaft, and advance such a length of wire as will produce one pin. A die cuts off the said length of wire by the descent of its upper chap; the chap then opens a carrier, which takes the pin to the pointing apparatus. Here it is received by a holder, which turns round, while a bevel-edged file-wheel rapidly revolves, and tapers the end of the wire to a point. The pin is now conducted by a second carrier to a finer file-wheel in order to finish the point by a second grinding. A third carrier then transfers the pin to the first heading die, and by the advance of a steel punch the end of the pin-wire is forced into a recess whereby the head is partially swelled out. A fourth carrier removes the pin to the second die, where the heading is perfected.

Fish-hooks are manufactured from well-selected steel wire, and tempered so as to give them the proper degree of rigidity. A very large collection will be found in this court, and every variety of hook, whether for fly-fishing, for angling, or for deep-sea fishing will be found here.

BUTTONS are divided between this class and Hardware: covered buttons will also be found in the Gallery.

The art of button-making is divided into several branches, constituting so many distinct trades. Metal, horn, leather, bone, and wood are the substances frequently employed for buttons, which are either plain, or covered with silk, mohair, thread, or other ornamental materials. The most durable and ornamental buttons are made of various metals, polished, or covered with an exceedingly thin wash, as it is termed, of silver or gold.

The buttons intended to be covered with silk, &c., are termed in general *moulds*. They are small circles, perforated in the centre, and made from those refuse chips of bone which are too small for other purposes. For the large and coarser buttons, pieces of hard wood are sawn into thin flakes, of an equal thickness; from which, by a machine, the button moulds are cut out at two operations.

White metal and brass buttons, as well as plated buttons, are stamped by the fly-press, out of copper plate, covered on one side with silver at the flatting-mill. The copper side is placed upwards in stamping, and the die or hole through which they are stamped is rather chamfered at its edge, to make the silver turn over the edge of the button. The backs are stamped in the same manner as the gilt buttons. The shanks are soldered on with silver solder, and heated, one by one, in the flame of a lamp, with a blow-pipe urged by bellows. The edges are now filed smooth in the lathe, care being taken not to remove any of the silver which is turned over the edge. They are next dipped in acid, to clean the backs, and boiled in cream of tartar and silver, to whiten them: after which they are burnished, the backs being first brushed clean by a brush held against them as they revolve in the lathe. The mode of burnishing is the same as for gilt buttons. When the buttons are first cut they have exceedingly sharp edges, to correct which and to produce a round, smooth, wirelike edge, they are rolled between two parallel pieces of steel, one moving horizontally past the other, which is fixed, and both of them containing polished grooves on their corresponding faces.

Button shanks are made by hand from brass or iron wire, bent and cut by the following means :—

The wire is lapped spirally round a piece of steel bar. The steel is turned round by screwing it into the end of the spindle of a lathe, and the wire by this means lapped close round it till it is covered. The coil of wire thus formed is slipped off, and a wire fork or staple with parallel legs put into it. It is now laid upon an anvil, and by a punch the coil of wire is struck down between the two prongs of the fork, so as to form a figure 8, a little open in the middle. The punch has an edge which marks the middle of the 8, and the coil being cut open by a pair of shears along this mark, divides each turn of the coil into two perfect button shanks or eyes.

Buttons to be gilded are stamped out from copper (having sometimes a small alloy of zinc), laminated in the flatting-mill to the proper thickness. These circular pieces, called blanks, are annealed in a furnace to soften them; and the maker's name, &c., is struck on the back by a monkey, which is a machine very similar to a pile engine. This stamp also renders the face very slightly convex, that the buttons may not stick together in the gilding process. The burnishing is performed by a piece of hematite or blood-stone, fixed into a handle, and applied to the button as it revolves by the motion of the lathe.

A great number of the buttons, thus prepared for gilding, are put into an earthen pan, with the proper quantity of gold to cover them, amalgamated with mercury in the following manner:—The gold is put into an iron ladle, and a small quantity of mercury added to it; the ladle is held over the fire, till the gold and mercury are perfectly united. This amalgam being put into the pan with the buttons, as much aquafortis, diluted with water, as will wet them all over, is thrown in, and they are stirred up with a brush, till the acid, by its affinity to the copper, carries the amalgam to every part of its surface, covering it with the appearance of silver. When this is exposed to the action of heat the volatile mercury escapes, leaving a layer of gold upon the metal. The electrotype process of gilding is now frequently applied.

Glass buttons are made by actually fusing glass upon metal surfaces. Horn buttons are stamped out. The importance of the button-trade may be conceived, when it is stated that one Birmingham house alone has upwards of 10,000 double sets of steel dies for livery buttons alone.

The manufacture of hooks and eyes from wire scarcely requires any description.

FILES AND OTHER TOOLS.

Exhibitors.—C. Cammell and Co. (6432), Shortridge, Howell and Co. (6456), J. Spencer and Sons (6460), Turton Brothers (6466), T. Turton and Sons (6467), M. Eadon and Sons (6499), E. Saggerson (6547), W. Molyneux (6536).

This well-known instrument—used for abrading the surfaces of metal, ivory, wood, &c.—requires an exactness of manufacture which is but little understood or appreciated.

When the teeth of these instruments are formed by a straight, sharp-edged chisel, extending across the surface, they are properly called files; but when by a sharp-pointed tool, in the form of a triangular pyramid, they are termed rasps. The former are used for all the metals, as well as ivory, bone, horn, and wood; the latter for wood and horn.

Files are divided into two varieties, from the form of their teeth. When the teeth are a series of sharp edges, raised by the flat chisel, appearing like parallel furrows, either at right angles to the length of the file, or in an oblique direction, they are termed *single cut*. But when these teeth are crossed by a second series of similar teeth, they are said to be *double cut*. The first are fitted for brass and copper, and are found to answer better when the teeth run in an oblique direction. The latter are suited for the harder metals, such as cast and wrought iron and steel. Such teeth present sharp angles to the substance, which penetrate it, while single cut files would slip over the surface of these metals. The double cut file is less fit for filing brass and copper, because its teeth would be very liable to become clogged with the filings.

Files are also called by different names according to their various degrees of fineness. Those of extreme roughness are called rough; the next to this is the bastard cut; the third is the second cut; the fourth, the smooth; and the finest of all, the dead smooth. The very heavy square files used for heavy smith-work are sometimes a little coarser than the rough; they are known by the name of rubbers.

Files are also distinguished from their shape, as flat, half-round, three-square, four-square, and round. The first are sometimes of uniform breadth and thickness throughout, and sometimes tapering. The cross section is a parallelogram. The half-round is generally tapering, one side being flat, and the other rounded. The cross section is a segment of a circle varying a little for different purposes, but seldom equal to a semicircle. The three-square generally consist of three equal sides, being equilateral prisms, mostly tapering; those which are not tapering are used for sharpening the teeth of saws. The four-square has four equal sides, the section being a square. These files are generally thickest in the middle, as is the case with the smith's rubber. In the round file the section is a circle, and the file generally conical.

Files are usually cut by hand; various machines have been constructed for cutting files, but none of them appear to have realized the condition required in all respects. The file being cut, must be brought to the requisite degree of hardness, which is a very delicate operation. Three things are strictly to be observed in hardening; first, to prepare the file on the surface, so as to prevent it from being oxidated by the atmosphere when the file is red hot, which effect would not only take off the sharpness of the tooth, but render the whole surface so rough that the file would, in a little time, become clogged with the substance it had to work. Secondly, the heat ought to be very uniformly red throughout, and the water in which it is quenched, fresh and cold, for the purpose of giving it the proper degree of hardness. Lastly, the manner of immersion is of great importance, to prevent the files from warping, which in long thin files is very difficult.

PLANES.

Exhibitors.—**C. Badger (6483), G. Diggins (6497), G. Eastwood (6500), E. A. and W. Greensdale (6510), G. Kerr (6524), King and Peach (6525), C. Nurse (6541).**

The carpenter's plane is too well known to require any description. The knife of the plane differs in no respect from any other piece of cutlery in its manufacture. An excellent description of tools of this kind will be found in Holtzapffel's excellent work "On Mechanical Manipulation."

SPRINGS.

Exhibitors.—**G. Goodman (6435), T. Hoey and Co. (6438), Kirby, Beard, and Co. (6440), W. Knights and Co. (6441), W. Mitchell (6445), J. Owen (6449), J. Spencer and Sons (6460), G. L. Turney (6464).**

The character of a spring is determined by its elasticity. At the same time, as it is capable of being bent, it must not be liable to break, and it should constantly return to its original shape, and continue to do this for any number of times, but this can only be secured by using steel of superior quality—by great care in its manufacture, especially in the process of tempering.

WIRES FOR CRINOLINE.

Exhibitors.—**Hadfield and Shipman (6436), G. W. Reynolds and Co. (6453), J. Peace and Co. (6451).**

SUNDRIES.

Exhibitors.—**E. J. Buxton and Co. (6494), J. H. Gray (6509). W. H. Mitchell (6535).**

One—and only one—redeeming feature belongs to the absurdity of female dress; which is, the fact that the demand for crinoline wire—when the steel trade was otherwise in a very depressed condition—kept the works at Sheffield in active operation.

That ample foldings are graceful, no one with an eye for the beauty of waving lines can deny; but the fashion of producing amplitude of skirts by means of rigid hoops of metal, argues a very low state of inventive art in our dress-makers; and, however extravagant the width of the garment, spread over these steel bands, may be, and however extensive the flounces covering them, the art producing the extension cannot be hid. Elegance is the point aimed at by the ladies; but if they were not under the enchantment of the tyrant Fashion, they would soon perceive that they cannot bend their bodies without producing lines which belong to the grotesque. The true punishment for the Age to endure, would be to have it symbolized by the erection of a statue in the prevailing style of dress, by which it would be a subject of ridicule through all time.

The sundries include tools of every kind, skates, and plated articles. These last are noticed with the precious metals and their imitations.

PENS AND PENHOLDERS.

Exhibitors.—C. Brandauer and Co. (6429), Caldwell Brothers (6431), J. Gillott (6434), Hinks, Wells, and Co. (6437), W. Mitchell (6444), Myers and Son (6447), J. Perry and Co. (6452), G. Schelhorn (6455), A. Sommerville and Co. (6459), M. Turnor and Co. (6465).

As peculiar elasticity is required in these pens, now so commonly used, the best metal, made from either Dannemora or hoop iron, is selected and laminated into slips about 3 feet long, and 4 inches broad, of a thickness corresponding to the desired thickness and flexibility of the pens. These slips are subjected to the action of a stamping-press. The point destined for the nib is next introduced into an appropriate gauged hole of a little machine, and pressed into the semi-cylindrical shape; where it is also pierced with the middle slit, and the lateral ones, provided the latter are to be given. The pens are now cleaned, by being tossed about among each other, in a tin cylinder, about 3 feet long, and 9 inches in diameter; which is suspended at each end upon joints to two cranks, formed one on each of two shafts. The cylinder, by the rotation of a fly-wheel, acting upon the crank-shafts, is made to describe such revolutions as agitate the pens in all directions, and polish them by mutual attrition. In the course of four hours several thousand pens may be finished upon this machine.

When steel pens have been punched out of the softened sheet of steel by the appropriate tool, fashioned into the desired form, and hardened by ignition in an oven and sudden quenching in cold water, they are best tempered by being heated to the requisite spring elasticity in an oil-bath. The heat of this bath is usually judged of by its appearance to the eye; but this point should be correctly determined by a thermometer, and then the pens would acquire a definite degree of flexibility or stiffness, adapted to the wants and wishes of the consumers.

The following description of the pens made at the works of Joseph Gillott, Birmingham, was written by Mr. W. C. Aitkin, of Birmin ham, for the Illustrated Catalogue of the Great Exhibition of 1851. It applies equally to the International Exhibition of 1862. Steel pen making may be briefly described as follows:—The steel is procured at Sheffield; it is cut into strips, and the scales removed by immersion in pickle composed of dilute sulphuric acid. It is passed through rollers, by which it is reduced to the necessary thickness; it is then in a condition to be made into pens, and is for this purpose passed into the hands of a girl, who is seated at a press, and who, by means of a bed and a punch corresponding, speedily cuts out the blank. The next stage is piercing the hole which terminates the slit, and removing any superfluous steel likely to interfere with the elasticity of the pen; at this stage they are annealed in quantities in a muffle, after which, by means of a small stamp, the maker's name is impressed upon them. Up to this stage the future pen is a flat piece of steel: it is then transferred to another class of workers, who by means of the press make it concave, if a nib, and form the barrel, if a barrel pen. Hardening is the next process: to effect this a number of pens are placed in a small iron box and introduced into a muffle; after they become of a uniform deep red, they are plunged into oil; the oil adhering is removed by agitation in circular tin barrels. The process of tempering succeeds; and finally the whole are placed in a revolving cylinder with sand, pounded crucible, or other cutting substances, which finally brightens them to the natural colour of the material. The nib is ground with great rapidity by a girl, who picks it up, places it in a pair of suitable plyers, and finishes it with a single touch on a small emery wheel. The pen is now in a condition to receive the slit, and this is also done by means of a press; a chisel or wedge with a flat side is fixed to the bed of the press; the descending screw has a corresponding chisel cutter, which passes down with the minutest accuracy: the slit is made, and the pen is completed. The last stage is colouring brown or blue; this is done by introducing the new pens into a revolving metal cylinder, under which is a charcoal stove, and watching narrowly when the desired tint is arrived at. The brilliancy is imparted by means of lac dissolved in naphtha; the pens are immersed in this and dried by heat. Then follow the counting and selecting. Women are mostly employed in the manufacture, with skilled workmen to repair and set the tools. In this manufactory there are employed upwards of five hundred hands, of which four-fifths are women. The manufactory has been established upwards of thirty years, and has been the means of introducing many improvements in the manufacture.

Between these two descriptions there will be little difficulty in understanding the processes employed for the production of these very useful articles. Since steel necessarily corrodes by the constant action of the acids in the ink, it has been thought that they would be protected by coating them with gold or silver; and this has been effected by the electrotype process. In most cases, however, the thin film of gold is rapidly removed, and the protection therefore afforded is very small. The manipulatory details in the manufacture of gold and silver pens are so nearly similar to those above described, that it is unnecessary to repeat them. The best gold pens are tipped with the native alloy, which is a compound of OSMIUM and IRIDIUM, fine examples of which may be seen in the fine case of the rarer metals exhibited by Johnson and Matthey in Class I.

GENERAL CUTLERY.

Exhibitors.—R. Barker and Son (6485), W. Beach (6486), G. Beardshaw (6487), H. C. Booth and Co. (6490), Champion and Co. (6495), J. Drabble and Co, (6498), G. Gallienne (6504), J. Gibbins and Sons (6505), Gilbert Brothers (6506), R. Gorrill and Son (6508), J. Greer (6511), T. Hardy (6513), Hargreaves, Smith, and Co. (6514), J. Haslam and Sons (6515), W. Hawcroft and Sons (6516), J. Haywood and Co. (6517), T. Kingsbury (6526), Mappin Brothers (6528), Mappin and Co. (6529), Marsh Brothers and Co. (6530), B. Matthewman and Sons (6531), B. Matthewman, jun. (6532), Mechi and Bazin (6533), J. Moseley and Son (6539), R. Mushet and Co. (6540), Peace, Ward, and Co. (6544), J. Rodgers and Sons (6545), Saynor and Cooke (6548), W. Shirley (6550), Steer and Webster (6551), Unwin and Rogers (6556), G. Ward (6558), T. Ward (6559), T. Wilkinson and Son (6560), W. Wilkinson and Sons (6561), B. Winks and Sons (6562), G. Wostenholm and Sons (6563).

Three kinds of steel are made use of in the manufacture of different articles of cutlery, viz., common steel, shear steel, and cast steel. Shear steel is exceedingly plastic and tough. All the edge tools which require great tenacity without great hardness are made of it, such as table-knives, scythes, plane-irons, &c.

Cast steel is formed by melting blistered steel in covered crucibles, with bottle glass, and pouring it into cast-iron moulds, so as to form it into ingots; these ingots are then taken to the tilt, and drawn into rods of suitable dimensions. No other than cast steel can assume a very fine polish, and hence all the finer articles of cutlery are made of it, such as the best scissors, pen-knives, razors, &c.

Formerly cast steel could be worked only at a very low heat; it can now be made so as to be welded to iron with the greatest ease. Its use is consequently extended to making very superior kinds of chisels, plane-irons, table-knives, &c.

The steel called common steel is employed in making the very common articles, but for the greatest part of table-knives which require a surface free from flaws, shear steel and cast steel are generally preferred. That part of the knife termed the blade is first rudely formed and cut off. It is next welded to a rod of iron about ½ inch square, in such a manner as to leave as little of the iron part of the blade exposed as possible. A sufficient quantity of the iron now attached to the blade is taken off from the rod to form the bolster or shoulder, and the tang.

In order to make the bolster of a given size, and to give it at the same time shape and neatness, it is introduced into a die, and a swage placed over it; the swage has a few smart blows given it by the striker. This die and swage are, by the workmen, called prints.

After the tangs and bolster are finished, the blade is heated a second time, and the foreman gives it its proper anvil finish: this operation is termed smithing. The blade is now heated red hot, and plunged perpendicularly into cold water. By this means it becomes hardened. It requires to be tempered regularly down to a blue colour; in which state it is ready for the grinder.

The blades of pocket-knives, and all that come under the denomination of spring knives, are made in the same way.

The forging of razors is performed by a foreman and striker, as in making table-knives.

They are generally made of cast steel. The rods, as they come from the tilt, are about ½ inch broad, and of a thickness sufficient for the back of a razor.

There is nothing peculiar in the tools made use of in forging razors: the anvil is a little rounded at the sides, which affords the opportunity of making the edge thinner, and saves immense labour to the grinder.

Razors are hardened and tempered in a similar manner to pen-knives. They are, however, left harder, being only let down to yellow or brown colour.

The forging of scissors is wholly performed by the hammer, and all the sizes are made by a single hand. The anvil of the scissor-maker weighs about 1½ cwt.; it measures, on the face, about 4 by 11 inches. It is provided with two gates or grooves for the reception of various little indented tools termed by the workmen bosses: one of these bosses is employed to give proper figure to the shank of the scissors; another for forming that part which has to make the joint; and a third is made use of for giving a proper figure to the upper side of the blade. There is also another anvil placed on the same block, containing two or three tools called beak-irons, each consisting of an upright stem about 6 inches high, at the top of which a horizontal beak projects; one of these beaks is conical, and is used for extending the bow of the scissors; the other is a segment of a cylinder with the round side upwards, containing a recess for giving a proper shape and smoothness to the inside of the bow.

The shank of the scissors is first formed by means of one of the bosses, above described, leaving as much steel at the end as will form the blade. A hole is then punched about ¼ inch in width, a little above the shank. The blade is drawn out and finished, and the scissors separated from the rod a little above the hole. It is heated a third time, and the small hole above mentioned is extended upon the beak-irons so as to form the bow. This finishes the forging of scissors. They are promiscuously made in this way, without any other guide than the eye, having no regard to their being in pairs. They are next annealed for the purpose of filling such parts of them as cannot be ground, and afterwards paired.

The very large scissors are made partly of iron, the blades being of steel.

After the forging, the bow and joints, and such shanks as cannot be ground, are filed. The rivet hole is then bored, through which they are to be screwed or riveted together.

This common kind of scissors is only hardened up to the joint. They are tempered down to a purple or blue colour. In this state they are taken to the grinder.

VARIOUS TOOLS.

Exhibitors. **J. B. Addis (6480), S. J. Addis (6481), T. Allarton and Powell (6482), W. Baker (6484), W. J. Bond (6489), H. Brown and Sons (6492), J. Buck (6493), J. Cochbain (6496), M. Eadon and Sons (6499), T. Frith and Sons (6501), J. C. Fletcher (6502), J. H. Fuller (6503), W. Gilpin, sen. and Co. (6507), A. Hannah (6512), S. Heath (6518), J. Howarth (6520), Jackson, Newton, and Co. (6521), J. and T. Jolley (6522), T. Jowitt and Son (6523), Marsh Brothers and Co. (6530), W. T. Molyneux (6536), T. Monk (6537), J. Moseley and Son (6538), R. Mushet and Co. (6540), F. Parkes and Co. (6542), J. Parkin (6543), T. Russell and Co. (6546), J. Shaw (6549), W. Sutton and Sons (6552), H. Taylor (6553), R. Thomas (6554), M. Tuton (6555), W. Waldrow and Sons (6557), T. Bolsover (6488), J. V. Hill (6519), R. and J. Linneker (6527), J. W. Mitchell (6534).**

The display of tools is an exceedingly good one. There does not appear to be any marked advance in the manufacture. A few years since, a great quantity of tools and implements were manufactured for the American market with very inferior metal. This brought—as every departure from honesty ever brings—its own punishment, and to this day the tool trade suffers for those sins. A more healthful state of things has returned, and articles of good quality are, as the rule, now manufactured.

Of course, many of the large and highly respectable manufacturers continued their uniform course, and never sent anything into the market the character of which was not well determined.

But few of the tools require any notice. Fuller and Davidson's tube-cutter is a useful instrument. The cutter is fixed by means of a screw so as to bear powerfully upon the iron tube to be cut, which is secured from lateral motion by means of a die also adjusted by a screw—when fixed, the instrument is turned by hand; and the surface of the tube when severed is as true and smooth as if cut off in the lathe.

The labour is much less than in filing, and the time saved is immense. A piece of ½-inch iron tube may be easily cut off in one minute; a piece of 1-inch in one and a half minute; a piece of 2-inch in four minutes; and other sizes in proportion. A groove may be cut any depth round a tube, if required, or the tube can be severed. The stocks and dies exhibited by John H. Fuller are well known, and the patent of Williams and Fuller fully appreciated by those who use screw tackle. Some of the instruments now exhibited show many improvements. By the arrangement of the regulating screw within the stock, the ordinary screw-handle (which is a constant source of annoyance, from its getting loose, being involuntarily unscrewed by the hand while in use, and even breaking off,) is entirely dispensed with, the stock being in one piece, while its shape is the most convenient for use, and free from the objection of throwing the screw on one side at starting, to which the ordinary angular stock is peculiarly open.

An interesting machine for testing steel by crushing, pulling, and rolling—as used by Messrs. Greenwood and Bailey—is a prominent object in this Court.

THE PROCESS COURT.

SITUATION OF COURT.—*It commences on the Western side of the Hardware Class, and is bounded on the North and West by Pottery. Entering from the Cromwell Road this interesting Court will be found immediately within the Industrial Division of the Building, on the right hand.*

In this Court will be found examples of processes which are described for the most part in the Classes to which they respectively belong. A few things, however, appear to require especial notice.

CLAY PIPE MAKING.

Exhibitor.—J. Reynolds (1691).

This exhibitor shows the process of making the ordinary clay pipes. A rough resemblance of a pipe having been formed of clay, the stem has to be pierced, and it is here that all attempts to introduce machinery have failed, as this process depends solely upon the touch. The end of the stem is held lightly between the forefinger and thumb, and a wire having a small button at the end is pushed gently in. Should the wire not pass through in a straight line, the button will be felt at one side, when its course can be easily changed. The stem being pierced, the pipe is placed in an iron mould, slightly greased, and the bowl hollowed out by an iron pin being forced in with a lever.

Mr. Reynolds has discovered a process for preparing his clay by which he is enabled to make pipes that surpass meerschaum in whiteness, and are purer and lighter than any clay pipes hitherto produced. He professes to make so-called long "straw" pipes, with proportionately thinner and lighter stems than those of any other maker. The latter—for want of space—he is making at the Polytechnic.

MANUFACTURE OF NEEDLES.

Exhibitors.—Milward and Sons (1661).

A complete series of models, showing the process of making needles, are exhibited by this firm. The wire, which is particularly prepared for this purpose, is first cut into equal lengths, which are heated, placed in two iron rings firmly pressed down, and rolled backwards and forwards while red hot, by which process they are straightened. The pieces of wire, which are double the length of one needle, are then pointed at both ends on a dry stone turned by steam. This process was formerly fraught with considerable danger to the men, from their inhaling the dust from the stone and needles. Messrs. Milward and Sons obviate this by covering the grindstone by a tin hood, connected by a tube with a fan which revolves with great rapidity, and draws all the dust into the hood and through the tube. Being pointed, the wires are then placed under punches, by which the impressions of the eyes are made, and the latter pierced. This done they are threaded on metal pins, the heads filed down to a level with these, and the wires broken in half. The needles, which until now are quite soft, are then heated, and when red hot thrown into warm oil. This renders them hard and brittle, and has been found to answer better than water. To give them the necessary elasticity they are again gradually heated and turned on hot plates. The fine polish is given by placing a quantity of them in a cloth, with emery and oil, and rolling them backwards and forwards by steam pressure, after which they are washed in soap and water, and thrown into sawdust. The eyes are then polished and rounded and the needles are completed. An ingenious machine for counting these needles completes this exhibition. It consists of a small wheel which has one hundred notches on its periphery, each the size of a needle. This wheel is divided into four parts by a stop. The needles are placed under the wheel on an inclined plane, and every quarter turn of the wheel allows twenty-five needles to pass through. See also p. 15.

SEWING-MACHINES.

Exhibitors.—Newton and Wilson (1675).

These exhibitors have a display of articles made by their sewing-machines, including every description of millinery.

The use of these machines is very simple and is now becoming general.

Newton and Co. have a machine, patented by Grover and Baker, which has a new stitch, called by them the "lock-stitch." This latter requires no fastening off at the end of the work, and will not unravel if cut. As samples of their work, Messrs. N. and Co. exhibit some ornamental stitching—a beautifully-finished bonnet, and a gentleman's shirt having five hundred plaits in the front.

The sewing-machine has been already described, vol. i., pp. 254—286.

MANUFACTURE OF LEAD PENCILS.

Exhibitor.—B. Cohen (1571).

This exhibitor shows the process of making lead pencils, excepting the forming of the lead into strips, which is done by hydraulic pressure. The wood, which is prepared in slabs of the required thickness, is cut into square pieces by means of a cutting gauge. The groove to receive the lead is then made, by means of a plane called a "plough;" the lead is glued and placed in the groove, and the upper piece of wood glued on. This done and the pencils being dry, they are rounded by means of hollow planes. In this country plumbago has been found most abundantly in Cumberland. The mountain at Borrowdale, in which the black lead is mined, is nearly 2,000 feet high, and the entrance to the mine is about 1,000 feet below its summit.

At one time as much as 100,000*l.* was realised from the Borrowdale mine in a year, the Cumberland plumbago selling at 45*s.* per pound. This mine has not, however, been worked for many years. The last great discovery, stated to have been about 30,000*l.*'s worth, has been hoarded by the proprietors, a small quantity only being sold every year; but it is now generally understood to be nearly exhausted. Some few years since the Borrowdale Black Lead Mine was inspected by three experienced miners, but their report was far from encouraging; notwithstanding which a new company was formed in 1859 to work this mine: they have not been successful, and the works are again suspended.

This plumbago in Borrowdale is found in "nests" in a trap rock, partially decomposed, which runs through the clay slate. In Glenstrathfarrar, in Inverness, it is found in gneiss; and at Craigman, in Ayrshire, it occurs in coal beds which have been formed in contact with trap. In Cornwall plumbago has been discovered in small lumps in the Elvan courses (see ELVAN); and on the northern coast of that country small pieces are picked out of the clay slate rocks, where it has been exposed by the wearing down of the cliffs.

A large quantity of plumbago, such as is used for this purpose, and which has been recently discovered, can be seen in the Russian Trophy in the Nave.

DIE SINKING.

Exhibitors.—T. Pinches and Co. (1686).

This firm shows the process of making medals by their "Small Lever Embossing Press." The process is simple, and needs no description.

PAPER BAGS.

Exhibitors.—C. T. Youngman (1751).

This exhibitor shows a machine for making paper bags by machinery. The same description of machine occurs in the Western Annex. See p. 257, vol. i.

NEWSPAPER ADDRESSING MACHINE.

Exhibitors.—Harrild and Sons (1613).

This is an ingenious machine for printing addresses, where large numbers are required, *i.e.* for newspaper offices. The addresses are set in type on a moveable slide, and the paper pressed down upon them at equal intervals.

LITHOGRAPH AND COPPER-PLATE PROCESS.

Exhibitors.—Day and Son (1582).

This is the usual process of drawing on stone, and printing off with greasy substances.

The term *lithography* is derived from *λιθος, a stone*, and *γραφη, writing*, and designates the art of throwing off impressions, upon paper, of figures and writing previously traced upon stone. The processes of this art are founded—

1. Upon the adhesion to a grained or smoothly-polished limestone, of an encaustic fat which forms the lines or traces.

2. Upon the power acquired by the parts penetrated by this encaustic, of attracting to themselves, and becoming covered with, a printer's ink, having linseed oil for its basis.

3. Upon the interposition of a film of water, which prevents the adhesion of the ink in all the parts of the surface of the stone not impregnated with the encaustic.

4. Lastly, upon a pressure applied to the stone, such as to transfer to paper the greater part of the ink which covers the greasy tracings or drawings of the encaustic.

The lithographic stones of the best quality are still procured from the quarry of Solenhofen, a village at no great distance from Munich, where this mode of printing had its birth. They resemble in their aspect the yellowish-white lias of Bath, but their geological place is much higher than the lias. Abundant quarries of these fine-grained limestones occur in the county of Pappenheim, along the banks of the Danube, presenting slabs of every required degree of thickness, parted by regular seams, and ready for removal with very little violence. The good quality of a lithographic stone is generally denoted by the following characters: its hue is of a yellowish-grey, and uniform throughout; it is free from veins, fibres, and spots; a steel point makes an impression on it with difficulty; and the splinters broken off from it by the hammer display a conchoidal fracture.

The Munich stones are retailed on the spot in slabs or layers of equal thickness; they are quarried with the aid of a saw, so as to sacrifice as little as possible of the irregular edges of the rectangular tables or plates. One of the broad faces is then dressed, and coarsely smoothed. The thickness of these stones is nearly proportional to their other dimensions; and varies from 1⅔ inches to 3 inches.

Many very fine examples of lithographic stones will be found in the Foreign Courts.

The process of printing a subject executed in lithography is as follows :—The drawing is first executed by the artist on the stone in as perfect and finished a manner as if done on paper or cardboard : the stone is then washed over with nitric acid diluted, with gum, which neutralises the alkali, or soap, contained in the chalk, fixes the drawing, and cleanses the stone at the same time : this is technically called *etching*. The acid is then washed off with cold water, and any particles of the crayon or other substances which may have adhered to the surface, are removed by the application of a sponge dipped in spirits of turpentine : the stone is now ready for printing ; it is slightly wetted, charged with printing-ink by means of a roller, the sheet of paper which is to receive the impression, is laid on it in a damp state, and the whole is passed through the press.

Chromo-lithography, as a beautiful medium of illustration, is now in very general use : the process may be thus described. A drawing of the subject, in outline, or transfer tracing-paper, is made in the ordinary way : when transferred to a stone, this drawing is called the *keystone*, and it serves as a guide to all the others, for it must be transferred to as many different stones as there are colours in the subject ; as many as thirty stones have been used in the production of one coloured print. The first stone required, generally for flat, local tints, is covered with lithographic ink where the parts should be of solid colour : the different gradations are produced by rubbing the stone with *rubbing-stuff*, or tint-ink, made of soap, shellac, &c., &c., and with a painted lithographic chalk where necessary ; the stone is then washed over with nitrous acid, and goes through the entire process described above. A roller charged with lithographic printing-ink is then passed over it to ascertain if the drawing comes as desired ; and the ink is immediately afterwards washed off with turpentine : if satisfactory, this stone is ready for printing, and is worked off in the requisite colour ; the next stone undergoes the same process for another colour, and so with the rest till the work is complete: it will, of course, be understood that before any simple impression is finished, it will have to pass through as many separate printings as there are drawings on stones.

Mr. Waring's work, which is to illustrate the Art Manufacture of the International Exhibition, is being executed here in chromo-lithography.

ALBION PRINTING-PRESS.

Exhibitor.—Mrs. Lavinia Jones (1634).

This will be described in the section devoted to Printing.

SILK VELVET.

Exhibitors.—S. and R. Robinson (1530).

A carpet loom, which has much of the character of the velvet power-loom, will be found in the Western Annex. This loom is worked by hand. The silk threads are woven over brass wires, by hand, and are then cut.

A variety of textile fabrics are worked with but little variation from the same loom. Amongst these may be named Fustian and Jean, which are tweeled cotton cloths. Of a similar character are cordings or corderoys. When the material is silk it is called velvet; when of cotton, velveteen. It is not possible, without diagrams, to explain the positions of the warp and woof threads, to give a correct idea of the process of weaving these cloths. The machine must therefore be inspected. The well-known velvet surface is produced by cutting after it is removed from the loom.

Preparatory to its being cut, the cloth is spread evenly upon a table about 6 feet long, upon each end of which a roller mounted with a ratchet-wheel is fixed; the one to give off, and the other to wind up the piece, in the above 6-feet lengths.

The knife is a steel rod about 2 feet long, and three-eighths of an inch square, having a square handle at the one end; the other end is tapered away to a blade, as thin as paper.

To prevent this point from turning downwards and injuring the cloth, its under side is covered by a guide which serves to stiffen it, as well as to prevent its lower edge from cutting the fustian.

The operative grasps the handle in the right hand, and insinuating the projecting point of the guide under the weft, pushes the knife smartly forward through the whole length of 6 feet, with a certain dexterous movement of the shoulder and right side, balancing the body meanwhile, like a fencer, upon the left foot. This process is repeated upon every adhesive line of the weft.

After being thus ripped up, it is taken to the brushing or teazling machine, to make it shaggy.

This consists of a series of wooden rollers, turning freely upon iron axles, and covered with tin-plate—rough with the burs of punched holes—and blocks of wood, whose concave under surfaces are covered with card-cloth, or card-brushes, and which are made to traverse backwards and forwards in the direction of the axes of the revolving rollers, during the passage of the cloth over them.

After they are brushed in the machine, the goods are singed by passing their cut surface over a cylinder of iron, laid in a horizontal direction, and kept red hot by a flue. They are now brushed again by the machine, and once more passed over the singeing surface, The brushing and singeing are repeated a third, or even, occasionally, a fourth time, till the cord acquires a smooth polished appearance.

The goods are next steeped, washed, and bleached by immersion in solution of chloride of lime. They are then dyed.

FILTERS, AND FILTER FOUNTAINS.

Exhibitors.—Atkins and Son (6828), Class XXXV.

The pocket filters exhibited consist of a hollow cake of carbon, with a glass tube, to which an india-rubber tube is attached. The ball can be put into water, and by drawing out the air from it, the fluid passes through and is filtered.

The value of charcoal as a purifying medium is owing to its being a porous, absorbing substance to an unusual degree, and possessing peculiar oxydising properties which have been so fully and fearlessly recognized of late, both in the filtration of water, and the "chemical reform of sewers," (*vide* Drs. Letheby, Stenhouse, and Messrs Haywood and Rawlinson's reports). Other substances which are non-absorbent as silica, flint, &c., are of secondary importance, as they effect only a straining mechanical filtration only. Substances of an organic, perishable nature, such as sponge, blotting-paper, cloth, flannel, &c., are positively detrimental, inasmuch as they speedily rot, and impart their own decaying impurities to the water in which they are placed.

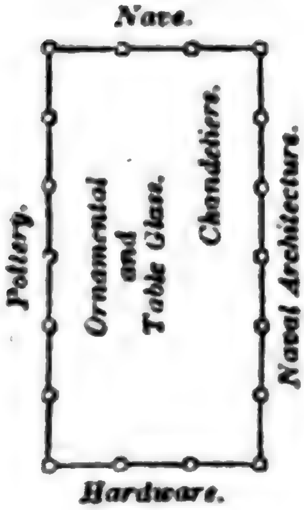
In the manufacture of the Patent Moulded Carbon, both sorts of charcoal are combined, and great care is taken to secure the purest kinds. The process of manufacture is to first grind the charcoals, together with a small portion of mineral charcoal to increase the action of the whole, in proper mills: then to form the ground powder into a plastic state, by means of carbonaceous bases, such as saccharine matter or bitumen, and shape them by hydraulic pressure, and lastly to carbonize the blocks in ovens with outlets for the volatilized products of combustion, leaving the blocks perfectly charred and free from taste and smell. These blocks are unalterable by temperature and insoluble in water. The form of the blocks is cylindrical, and the water percolates through the pores towards the centre into a cavity hollowed out according to requirements. The mode of fixing the blocks into the filtering vessels is by means of corks and glass tubes inserted through them. This method forms an inexpensive, simple, and beautiful moveable water-tight joint, and at the same time allows the blocks to be detached and cleansed by any person. Cleansing is effected by washing the surface of the blocks and blowing through the pores from the centre to the surface either by air or steam, which is distributed equally throughout the pores; the same arrangement also causes the impure water, in percolating through the blocks towards the centre, to be equally and surely filtered. The fountain, which is termed the "Patent Hydro Pneumatic Circulating Filter Fountain," is constructed of glass tubes bent into ornamental and graceful curves and devices, through which water and bubbles of air and gas previously filtered through patent moulded carbon, and charged with either oxygen or carbonic acid gas, alternately circulate at different speeds and in different directions. The fountain apparently circulates large quantities of water, but in reality only a few gallons are used in the twenty-four hours. The fountain, which is patented by Dr. Hobson, of Leeds, has been designed and executed by the exhibitors. The fountain exhibited contains 2000 feet of tubing. Another equally interesting and a more useful feature of the stand, is the introduction of nine outlets for the supply of purely filtered water, for the use of visitors to the Exhibition. These outlets are neatly contrived to issue from a series of geographical and geological delineations of the various sources of water as found in nature, accompanied by a pictorial surface representation of the globe from the south to the north pole. The grouping of the rocks and illustrations, which are at a convenient height to be readily observed, have been executed by Mr. J. J. Story, of Nottingham.

YOUNG'S PATENT TYPE COMPOSING AND DISTRIBUTING MACHINE.

Exhibitors.—Young's Patent Type Company (1750).

This is a very ingenious machine and ought to be of great value to printers, and particularly to newspaper offices; as it is stated to effect a reduction of fifty per cent. in cost and time. This machine is described in p. 258, vol. i.

Class XXXIV.—Glass, for Decorative and Household Purposes.



Number of Exhibitors, 79.

Situation of Class.—*This Class is immediately adjoining Naval Architecture on the Eastern side, Hardware on the South, and Pottery on the West.*

Position of Groups.—It is not possible to make any separation of the various examples given; they blend so entirely in arrangement.

GLASS.

The art of making glass was known at a very early period; and, omitting the account which Pliny gives of its accidental discovery by Phœnicians, as the heat could not, under the circumstances, have been sufficient for vitreous fusion, we find it mentioned by Herodotus, and possibly it is alluded to in the Book of Job—though the word translated "looking-glass" may mean one of the ancient metallic mirrors, of which so many still exist. Articles of glass are found in the ruins of the cities of Assyria; and a vase in the British Museum, obtained on the site of Nineveh, is probably the oldest specimen of glass in the world. Paintings in Thebes, about 3,500 years old, represent wine-vessels as made of glass; and Suetonius informs us that the ashes of Alexander the Great were given to Augustus in a casket of glass.

The Phœnicians were the earliest glass-makers; and for many ages they monopolized its manufacture. The glass-works of Sidon produced glass which was often engraved, cut, and brilliantly stained, and also excellent imitations of precious stones. The Egyptians were equally skilful; and the glass-houses of Alexandria rivalled those of Sidon. The Jews carried with them from Egypt a knowledge of glass-making; and the Romans became masters of it when they subdued that country. Glass-houses were established near Rome in the reign of Tiberius; but though cups of glass have been found at Pompeii, it was a costly article, being sometimes more highly valued than the precious metals. Fabulous prices are said to have been given for it, when of a superior kind: thus Nero is related to have paid 40,000*l*. for two cups of clear glass. The Romans are believed to have employed it occasionally in their theatres, in the form of hollow pillars, within which they introduced lights: they also encrusted apartments with it instead of with marble. The art of making glass was not confined to the more celebrated nations of antiquity: the Druids, it has been said, were sufficiently skilled in it for the manufacture of beads and amulets; but seeing that the beads found in the British tumuli—those which are common in the Egyptian tombs—and those which are still in use amongst the nations of Africa, are of the same character and pattern, and that these are all of them precisely similar to the Venetian beads made at the glass-houses of Murano, at the present day, they have a common, probably, a Phœnician origin. It passed from the Romans, and perhaps also from the East, to the Venetians; and Venice, from its very foundation, was famous for its glass-works. Indeed, the Venetians reduced the price of glass so considerably as to render it an article of ordinary use; and for three or four centuries they alone were able to make drinking-cups and mirrors. Even now their works in glass are looked upon as models of elegance and ingenuity; and at the present Exhibition a Venetian mirror is shown in a modernized form, as a very beautiful cheval-glass. Venice continued for a long time to excel in the manufacture of ornamental articles; but in the fifteenth and sixteenth centuries the opening of a way to the East by the Cape of Good Hope deprived her of various branches of her extensive and lucrative commerce, and of this among the rest. The mystery she had observed regarding it, and her exclusiveness, facilitated the catastrophe, and she was not only rivalled, but driven out of the market by other nations. The

Bohemians then became very successful in the manufacture of ornamental glass; and their productions, containing no lead, were particularly useful for many purposes. France would have been more celebrated than she ever was in this branch of industry, had not Louis IX. passed a law prohibiting any but the members of noble families from establishing glass-houses, or even working in them.

For a long time glass was only *blown*; but in the seventeenth century a mode of casting it was discovered, or at least revived. The first glass-house in England was established in Crutched Friars in 1557; but for a considerable period only the coarser articles were made, and even drinking-cups were not manufactured until the close of the seventeenth century. Looking-glass plates were first made by Venetian workmen at Lambeth in 1673, but they were only on a very small scale until a century later.

The English glass manufacture soon became very extensive, though it was crippled by harassing enactments. It was taxed for the first time in the reign of William and Mary, and the impost was variously modified at different subsequent periods. Since the duty on glass was removed in 1845, it has progressed rapidly, both in the quantity produced and the number of purposes to which it is applied. No substance is better adapted for domestic and ornamental uses; and the present freedom of its manufacture from vexatious restraints and oppressive duties is justly considered a very great advantage.

Glass was not used in windows until long after it was very commonly employed for other purposes. It was probably adopted in churches in France in the sixth, and in England in the seventh century; but so late as the middle of the sixteenth century it was very rare in ordinary buildings; and in the middle of the seventeenth century many houses in Scotland were unglazed—which is still true of those in remote districts of Spain, &c. The discovery in the sixteenth century of the power which the diamond possesses of cutting glass, greatly increased the usefulness, and extended the consumption of the latter.

Though the word "glass" is sometimes applied to any mineral substance that becomes transparent or translucent by heat, it is more usually confined to certain compounds of silex. The process of glass-making described by Pliny is nearly the same as that used at the present day. The glass from Nineveh, in the British Museum, has been turned in a lathe; this is seldom attempted at the present day, but grinding is somewhat analogous. Ancient writers mention a species of glass which was malleable; but the mode of making it, if ever known, has long since been lost.

Ordinary glass is essentially a compound of silex and an alkali; the alkali fuses the earthy particles, and imparts a tenacity when hot which renders the material capable of being moulded with great ease into any shape: without this, its other admirable qualities would be of little value. The nature of the glass depends on the proportion in which the ingredients are present; excess of alkali will form a glass useless for ordinary purposes, being soluble, and even deliquescent: a variation of the proportions gives a corresponding difference of properties. The earthy silicates, when subjected to a high temperature, are strong, and not vitreous, like the alkaline; even the silicates of alumina found in certain kinds of semi-fusible porcelain are only imperfectly transparent. Silicates of the heavy metals, even when vitreous, are usually dark and coloured, and they are easily acted upon by a variety of substances. None of the silicates, therefore, but those of the alkalies, and not even all of these, will answer the purposes to which glass is applied: indeed, no simple silicate is perfectly transparent, colourless, and insoluble; but by judiciously mixing two or more we obtain just what we require: the earthy and metallic silicates in combination lose their opacity and their tendency to crystallize, and the alkaline their solubility. The solubility of the alkaline silicates is greatly affected by the relative amounts of their constituents: one part silica and three parts alkali, affords an extremely deliquescent compound; but by reversing the proportions we obtain one that is not even soluble. The mixture of the earthy and metallic silicates fuses at a temperature less than that required by the earthy, and higher than that required by the metallic. The factitious differ from the native silicates, in being amorphous, that is, without a tendency to assume a crystalline form. The oxides of lead render glass very fusible, and greatly increase its density: hence, by giving it a higher refractive power, they render it more applicable to optical purposes. Manganese clears glass by depriving it of colour—unless added to excess, when it imparts a tint of its own. The decolourization of glass by manganese is a very beautiful example of chemical affinity and its results. It is founded on the fact, that peroxide of manganese prevents the iron, which may be present in the sand or other materials, from passing into its lower stage of oxidation, the protoxide of iron being a strong colouring agent. Arsenic is sometimes used in the manufacture of glass, to secure, in small quantities, brilliancy; in large proportions, opacity, or opalescence; though this latter peculiarity is more effectually secured by the use of oxide of tin. Borax is a most valuable addition to glass, but it is too costly to be employed to any great extent. Bohemian glass contains sand, potash, and lime: common English crown and plate glass contains sand, soda, potash, and lime: green bottle-glass, sand, soda, lime, alumina, and oxide of iron: flint-glass and crystal each contain lead, but the former in the larger quantity. Potash is better than soda, as it renders the glass more fusible, and less liable to decomposition.

Glass is manufactured either by blowing or casting. In making window glass by the former method, it is formed into either a hollow globe or cylinder: the globe, after having been slightly opened, is expanded into a sheet by centrifugal force: the cylinder, after having been slit at one side, is flattened. There is less waste with the cylinder, as there is no bull's eye: the glass is more uniform in thickness, which is very important if it is coloured; and it can be obtained in squares of greater size; but ordinarily it does not give so clean a glass. The method of making window-glass in this way, however, fell into disuse, but it has been reintroduced with great success. Crown-glass is manufactured on tables; inferior plate-glass is made by grinding the best kinds of common glass; superior plate-glass, by pouring the melted glass on a table and rolling it out with a heavy copper cylinder, which is often of very great weight; after which it is carefully ground and polished. The large sheets of plate-glass which are now produced, may be conceived from the mirrors found in various parts of the Exhibition building, and from the immense plates exhibited by France and Belgium in the Nave. The brilliancy of skilfully cut glass is well shown by Osler's case, also in the Nave. After having been moulded to the requisite shape, glass must be annealed, that is, must be gradually cooled down to ordinary temperatures: otherwise, it is liable to fly in pieces with the least movement, and often without being touched. "Prince Rupert's Drops" afford a very simple but excellent illustration of the peculiar qualities of unannealed glass; but the discoveries made regarding polarized light have placed them in a clearer point of view, and enable us with the greatest facility to detect any imperfection in the annealing.

Stained glass is intimately connected with ecclesiastical architecture, but its application in this way is comparatively of recent date. The ancients understood very well the methods of colouring glass, but it was easier for them to make it coloured than colourless; but they applied their knowledge only to the production of small articles of ornament, and utensils for domestic use: they do not seem to have thought of it as a means of modifying light, and giving to it an agreeable colour. The beads found in Egyptian tombs are examples of use made of coloured glass, in remote times. Stained glass, in the sense in which we use the expression, was created by the Church: it is almost a constituent of the Gothic style; and its various kinds have been a reference to the different modifications of that style. The use of stained glass in windows was at first intended to diminish the too great glare, particularly with the more decorated kinds of Gothic, which afforded spacious openings for the light, and to impart a religious gloom, which was especially useful in ceremonials that appealed to the senses rather than to the mind, and acted on the fears rather than on the intellect of the votary. The mosaic glass of the twelfth and thirteenth centuries had a special reference to the diminution and modification of light, the production of artistic effects being scarcely contemplated. It was composed of small pieces of coloured glass, and the results producible by these combinations continued for a long period to be sought after, even to the extent of breaking up draperies &c., into minute parts: a tendency which is very observable in the more ancient specimens of stained glass. The art of staining glass has not only been revived in modern times, but brought to great perfection, and some admirable examples of its capabilities are shown at the present Exhibition.

With the exception of charcoal, the colours used in staining glass are always metallic oxides: they are intimately mixed with, and fused into the substance of the glass, but may be applied superficially, and coloured facets of great beauty can then be produced by cutting through the colour. The painter on glass has to contend not only with the difficulties of the ordinary artist, but with others, in addition, which are peculiar to his work; his colours are modified in tint, by the vehicle through which he applies them: and he must foresee the changes produced upon them by firing.

Although different metals are usually employed to produce the different colours, a variety of tints may be imparted by a single metal, according to its state of oxidation, or the temperature to which the glass is raised. This fact has been, to a certain extent, long known: but it has been fully developed by Bontemps since 1851. It was ascertained very early that gold produces a colourless glass, until heated to redness, when it becomes red; and that a colourless glass containing copper becomes green by heating: these, however, were trifles, compared with what is known on the subject at present.

With this brief introduction we must ask the reader to visit the various glass departments in the building, and examine the most beautiful specimens for himself; but we would suggest that his highest award of judgment be given first to form, and secondly to design—to "form," because through its means we approach the first elements of beauty in Nature (as witness the tazza exhibited by Powell and Sons, copied from antique vases in the South Kensington Museum, no doubt originally suggested by some water-lily)—and to "design," because the intellect is more involved in the process of creating, than in the mere mechanical skill of engraving and cutting.

SUB-CLASS A.—STAINED GLASS, AND GLASS USED IN BUILDINGS AND DECORATIONS.

Exhibitors.—T. Baillie and Co. (6710), J. Ballantine and Son (6711), H. M. Barnett (6713), Chance, Brothers, and Co. (6716), Claudet and Houghton (6717), J. R. Clayton and A. Bell (6718), Cox and Son (6719), Field and Allan (6721), J. A Forrest (6722), A. Gibbs (6723), C. Gibbs (6724), J. Hardman and Co. (6725), J. Hartley and Co. (6726), Heaton, Butler and Bayne (6727), Holland and Son (6730), W. H. James (6731), C. Long (6732), J. Moore (6775), Morris, Marshall, Faulkner and Co., (6734), M. A. and W. H. O'Connor (6735), J. Powell and Sons (6737), F. Preedy (6738), A. Prince and Co. (6739), Rees and Baker (6740), Ward and Hughes (6741), J. P. Warrington (6742), W. Warrington, jun. (6743), W. Warrington, sen. (6744), Lavers and Barraud (6745), S. Baker and Co. (6712), J. Hetley and Co. (6729).

The antiquity of coloured glass is undoubted; but although mentioned as being employed for various ornamental purposes, it is very questionable if it was ever used for windows before the twelfth century. The glass in Nôtre Dame has been referred to the sixth century; but it evidently is not so old as that of St. Denis, which is stated to have been put up by the Abbot Suger, in 1150; but in 1194, there were recorded on the windows of St. Denis the events of the first crusade. The artists employed by Suger made it a boast that they used sapphires among their materials; this was probably cobalt, and it is likely that we hence derive the term Zaffre for the oxide of cobalt of commerce.

How rapidly the example of the Abbot of St. Denis was followed is proved by the magnificent glass of the thirteenth century abounding on the Continent, and partially existing in this country, the oldest examples we have being in Canterbury Cathedral. At first the ornaments consisted of mere diapering: then rude representations of saints and kings; then panels of various forms, with subjects from the Testaments, on grounds of blue or ruby, the intermediate parts filled with mosaic patterns, in rich colours, and the whole enclosed within a coloured border. In later styles, single figures predominated, with flowing patterns of foliage, and, later still, with canopies over them. Some of the finest works are by French and Flemish artists; and this art was traditionally known to the early Florentine painter, Cimabue, who is said to have introduced it into Italy. Probably our actual obligations are due to our Norman neighbours, as a necessary appendage to their architecture. It has been a popular notion that this art was lost to us; such is not the case: like all other arts, it declined after the Reformation, and has indeed been dormant, but never extinct.

Among the specimens of stained glass are to be particularly noticed the windows by J. Ballantine and Sons; that which contains the "Crucifixion" is intended for Prestolee Church, Lancashire; the figures of "St. John" and the "Poor Widow" are for All Saints' Church, Kensington Park; and the memorials of the battle of Falkirk for the locality in which it was fought. They also exhibit a window for the Free Church Presbytery Hall, Edinburgh, consisting of medallion heads of Wishart, Knox, Henderson, Erskine, Moncrieff, Thomson, McCrie, Chalmers, and Cunningham; and also windows for the National Bank of Scotland, Glasgow; having figures, groups, and emblems illustrative of Commerce, Mechanics, and Agriculture.

Besides various illustrations of the manufacture of window-glass, Chance Brothers and Co. exhibit leaded windows, the subjects being "Robin Hood's Last Shot," and the "Madonna and Child, with the Four Archangels." Forrest shows a glass window for the crypt of Glasgow Cathedral, containing

"The Wise Men's Journey to Bethlehem." The stained-glass windows exhibited by Hardman and Co. are remarkable; one of them is for Canterbury Cathedral, and contains the subjects originally painted on that which it is intended to replace; another is for Worcester, and contains passages from the life of Joshua: two were selected for the church of Whippingham, Isle of Wight, by the late Prince Consort; and various others are in styles of the thirteenth, fourteenth, and fifteenth centuries, being made for different ancient churches and cathedrals.

The stained-glass windows for St. Alban's Abbey and Harpenden Church, by Messrs. Heaton, Butler, and Bayne, contain, among other interesting subjects, the "Baptism of Our Saviour," "The Adoration," and some beautiful heraldic devices. The eight lower compartments of the great west window of Lavenham Church, in the style of the fifteenth century, by Messrs. Lavers and Barraud, containing the "Life of St. Peter," and their other specimens of stained glass, are well worthy of being examined. The painted glass for the great window of Aylesbury parish Church, probably of the date of 1420, by Messrs. O'Connor, comprehends a great number of interesting subjects, among which are "The Fall, and Restoration of Man," "The Passage of the Red Sea," and other incidents in the journey of the Israelites. Their figures of Isaiah, David, and Noah, for the west window of St. Matthias' Church, Stoke Newington, and some heraldic panels, are also extremely well executed; and a Norman window representing the "Birth, Crucifixion, and Ascension of Our Lord," and other circumstances of his life, by Messrs. Rees and Baker, are excellent specimens of English stained glass.

Warrington and Sons' windows consist of a number of figures, the principal ones being three large figures of the Apostles "Peter, James, and John," "Christ Receiving Little Children," and "The Crucifixion," and other designs of a secular sort.

Ward and Hughes have a collection consisting of groups illustrative of the "Life of Christ."

Baillie and Co. have a window for Morton Church, Bourne, Lincolnshire; and Clayton and Bell, Alexander Gibbs, and H. M. Barnett, Newcastle-on-Tyne, show a good collection of stained-glass, medallion, and foliage windows.

ORNAMENTAL AND USEFUL GLASS.

Exhibitors.—F. H. Brockwell (6759), M. L. Brown (6760), Mr. Copeland (6762), J. Defries and Sons (6763), Dobson and Pearce (6764), J. Garrett (6766), J. Green (6767), W. J. Hodgetts (6768), T. C. March (6773), J. Millar and Co. (6774), E. Moore and Co. (6733), Naylor and Co. (6777), Northumberland Glass Co. (6778), F. Osler and Co. (6779), W. Pearse and Co. (6780), Pellatt and Co. (6781), E. Phillips (6782), W. P. Phillips and Co. (6783), Sharpus and Cullum (6789), C. Sinclair (6790), Spiers and Son (6791), Storey and Son (6792).

On F. H. Brockwell's table will be found glass of various shapes and finish, some of it covered with fine wicker-work and leather, or mounted in silver; toilet-services, bottles for perfumes and salts, single and double, in various colours, mounted in silver and gold: also a sphere of solid glass 7 inches in diameter, cut in facets and mounted on an electro-plated stand. This is intended as a specimen of material and workmanship, and as such it may be regarded as a peculiarly fine example.

The Northumberland Glass Company are exhibitors of a massive and richly cut flint-glass dessert-service in the antique style, and gauge-tubes for steam-boilers.

E. Phillips has a fine display of candelabra, with richly cut pedestals and leafage arms; cut girandoles and candlesticks; various centre bowls and decanters; jugs, goblets, &c., engraved and otherwise ornamented.

T. Sharpus and Co. are exhibitors of richly cut and engraved decanters, water jugs, glasses, &c.

In the case of Messrs. Storey and Son will be found a service of cut glass, and a service of engraved glass in antique style, including decanters, glasses, vases, tazzas, &c.

Where there is so much excellence it is with difficulty that any selection can be made for description. To do this would be to repeat the Catalogue, which is not the purpose of the *Handbook.* We may, however, particularize the following:—

G. Millar and Co. are exhibitors of decanters, jugs, and goblets of various shapes, and decorated in different styles.

Mr. J. Green displays a glass chandelier and specimens of engraved glass, and of cut and gilt glass.

Naylor and Co. have a fine Etruscan vase decorated with figures; table services and flower glasses variously ornamented.

Pellatt and Co. are exhibitors of much very fine glass for the table and sideboard; decanters, goblets, and finger-glasses engraved and otherwise enriched; while W. P. and G. Phillips exhibit a glass table without any metal or other mounting; table and dessert services, specimens of green and ruby painted glass.

Mr. Toogood is an exhibitor of large and richly cut glass show jars, and which are considered good specimens of pure crystal glass, and rich cutting on large goods; also specimens of very richly cut flint glass for the toilet table, including bottles, jars, trays, ring-stands, &c., &c.

The engraved glass of Dobson and Pearse requires especial attention, owing chiefly to the exquisite design on many of the specimens; while Mr. Osler's case, in the Nave, containing what he terms "Lapidary Cutting," consists of objects unrivalled in their excellence, one of which, in the centre, has one thousand three hundred and sixty facets. Mr. Copeland, for plain cut jewelled glass, and Messrs. Phillips for coloured jewelled glass, are well known to the public: also Mr. James Green, and Messrs. Naylor, show beautiful examples of glass in its various forms; while as a curiosity the prismatic mirrors made for the Sultan of Turkey, by Messrs. Defries and Son, are extremely interesting. The curved spaces for which they were intended rendered it impossible to make ordinary mirrors of so large a size: but the difficulty was surmounted, by forming them of prisms which join at the sides, and seem to constitute a single piece, though each mirror contains one thousand prisms. The weight of the glass in each is one ton, and that of the metal back, the same: but they will be transported in pieces, and put together when they arrive at their destination.

The revivals of the style of the Venetian gilded, threaded, and frosted glass are exceedingly satisfactory. Venice was long celebrated for its glass manufacture, to which very great attention was paid, and every encouragement given by the republic. The Venetian glass is not remarkable merely for its form or ornamentation, but for its lightness, which arises from the absence of lead in its composition. The *millefiore*, or Venetian paper-weights, as they are called, were first manufactured at Venice: they consist of sections of rods of threaded glass, inclosed in a sphere of the ordinary glass; but the ancient specimens do not possess the regularity of the modern manufacture. Amongst the most striking of the revivals of the Venetian glass is the gilded set of bottles and glasses. The brown oxide of gold is employed for this purpose; it is ground up with a flux and some oil, applied with a brush subjected to a heat in a muffle sufficient to run the flux, and when cold burnished. The enamel-painting on glass is a more recent introduction.

GLASS LETTERS AND SHOP DECORATIONS.

Exhibitors.—Hooman and Co. (6769), G. Jennings (6770), Lloyd and Summerfield (6772), W. Readwin (6786), R. Royston (6787), J. G. Price (6785), Lavers and Co. (6799), B. Edmett (6720).

There are some novelties in glass exhibited by Hooman and Co., as cut crystal and opal letters, and embossed gilt plates for facias. The writings and decorations on glass by G. Jennings, in gold and colours; a plate-glass chess-board in gold, and imitations of malachite, and various marbles, are exceedingly good.

Embossed and gilt plate-glass panels with heraldic emblems, and copies of antique and modern letters have much of novelty. Amongst the new applications of glass there are exhibited by Lloyd and Summerfield, crystal glass bars for shop windows, with arched heads and spandrils of plate-glass decorated with silver patterns on a black ground: also specimens of cut and engraved glass.

R. Royston, illuminated and gilt alphabets, ancient and modern; the former selected from celebrated manuscripts, &c., the latter including the best specimens at present in use for shop facias, &c.

J. Price is also an exhibitor of ornamental letters, embossed, gilt, &c.

GLASS TILES.

Exhibitors.—Bowron, Baily and Co. (6758).

Messrs. Bowron, Baily and Co. exhibit glass tiles formed in moulds, and of various patterns, according to the purposes for which they are intended. Some of them are ornamented in relief, &c., being made with holes for battening down like slates; they are not affected by the wind. Also glass basins for water-closets, and insulators for telegraph wires, including a kind intended for hot climates.

CHEMICAL AND SURGICAL GLASS.

Exhibitors.—J. Rust and Co. (6788), J. J. Wheeler (6795), W. Toogood (6793).

J. Rust and Co. exhibit bottles and chemical glasses. Soluble glasses of potash and soda, with a specimen of stone which has been subjected to a process for hardening and preserving it, by means of a preparation of glass, are also exhibited. The use of the soluble silicates has been long recommended. Kuhlman and Fuchs have both strongly advocated its use for preserving stone, and Mr. Ransome has patented a process in this country, in which the silicate of soda is largely employed.

J. J. Wheeler, specimens of medical and surgical glass, including stoppered bottles made from tubing, acid brushes, and syringes for the teeth, &c.; also a working model of the steam-engine, in glass.

PHOTOGRAPHS IN GLASS.

Exhibitors.—Hooman and Maliskeski (6769).

There is some originality in the idea of thus enclosing photographs in glass: but it partakes of the same peculiarities as the process of hermetically closing porcelain medallions in glass, and even plaster figures, with the effects of which most persons are very familiar.

GLASS BOTTLES.

Exhibitors.—Aire and Calder Glass Bottle Co. (6756), Alexander, Austin, and Poole (6757), Bowron, Baily and Co. (6758), Kilner Brothers (6771), J. Powell and Sons (6800).

Bottle-glass is manufactured extensively at Newcastle-upon-Tyne, and some other parts; the excessive cheapness of slack or small coal being the great inducement. The composition of the Newcastle bottle-glass has been stated to be—

Common white sand	100	parts.
Coarse kelp	40	„
Wood ashes	160	„
Yellow clay, or brick earth	80	„
Broken glass	100	„

At Newcastle, too, lime and sea-sand are employed; the soda being derived from sea water, with which the mass is wetted, and which, on evaporating, deposits its salt.

Ordinary bottle-glass consists of silica, 53·55; potash, 5·48; lime, 29·22; alumina, 6·01; oxide of iron, 5·74.

Although the manufacture of ordinary glass bottles may appear to occupy a low position in this important branch of industry, it gives rise to many ingenious processes and much skilful manipulation.

Before the repeal of the duty on glass, the revenues from bottle-glass amounted to nearly, or full, a third of the entire sum raised by that duty. The chief seat of manufacture was on the banks of the Lynn and the Wear, but the present production of Pontefract is nearly, if not quite, equal in extent to the districts before named. In the Aire and Calder Company's Works, about 20,000 bottles are made five days in the week; about the same quantity are made by three smaller firms in the same place, and about double the quantity are made in other districts in Yorkshire—which gives a total weekly production in that county alone of about 400,000 bottles.

Since the repeal of the glass duties, the forms of bottles have become greatly diversified. The present exhibitors make nearly 800 different shapes and sizes. Art has not done much to improve bottle-making, as many of the forms used are crude and shapeless, and leave much room for improvement; a bar may, however, be said to exist in the fact, that however elaborate the pattern may be, the workmen are expected to produce as many for the day's work, as others of a simpler shape.

For the common kind of bottles, coarse and inexpensive materials are used, consisting of lime, chalk, or soap-makers' waste, with any common silicious sand, clay, or marl, and common sulphate of soda. For the pale glass bottles of the best kind, more expensive materials are employed, its composition differing little from the best descriptions of crown and plate glass; but from rather more lime being present, it is harder and more brittle.

Of late, glass bottles have suffered a great declension in price. Reference to a wine-merchant's bill, previous to the repeal of the duty, will exhibit a charge of three and even four shillings per dozen for bottles, and its settlement often formed the most unpleasant part of the bill.

SHEET, PLATE, AND CROWN GLASS.

Exhibitors.—Chance Brothers and Co. (6797), S. Barker and Co. (6712).

The name of crown glass is given to the best kinds of glass commonly employed in making windows. Into this, no lead or other metallic oxide enters as a fluxing agent; but manganese and cobalt are sometimes employed to improve its colour. In England, ordinary crown glass has usually been made of fine Lynn sand, kelp, and slacked lime.

The kelp, which was formerly largely employed and manufactured from sea-weed in the Orkneys, is now chiefly replaced by the soda-cake.

A very superior quality of crown glass is made by the mixture of—

220 parts by weight of white sand;
60 „ „ purified pearlash;
30 „ „ saltpetre;
2 „ „ borax;
1 „ „ arsenic:

any yellow colour being corrected by the addition of a small quantity of manganese.

The ordinary crown glass is, as is shown, usually sent into the market in discs, about 60 inches in diameter. This is produced by gathering the quantity of glass on the end of the glass-bower's rod, which is blown and moulded to a peculiar form; the side opposite the tube is flattened by pressure, and a small portion of melted glass is collected at the end of a "punt," and applied to the centre of the flat side, the tube being removed by wetting the glass near their point of union, leaving a circular hole in the glass of about 2 inches in diameter; and this mass is held in the mouth of the furnace until it is sufficiently ductile. The workman then dexterously twirls the "punt" in his hand, slowly at first, and then more and more quickly, when the glass yields to the centrifugal impulse, and its diameter becomes greater and greater. The hole just mentioned expands proportionately, and when in this continued progression the doubled portion opposite to the iron rod, and between the periphery of the glass and the orifice is diminished to an annulus or ring, only a few inches wide; this, in an unaccountable manner, instantly flies completely open, and the sheet is formed of uniform thickness, with the exception of the spot where it is attached to the iron rod, and where there is a kind of knot or lump, which is called a bull's eye.

Sheet glass, as we have already stated, is blown as a cylinder, rolled, and being cut the length of the cylinder, is spread out on a table, and flattened and polished.

Plate-glass.—The composition of plate-glass varies considerably, some manufacturers introducing materials which are not to be found in the glass obtained from other works. The general composition is stated to be the following:—

Fine white sand	300	pounds.
Soda	200	„
Lime	30	„
Oxide of manganese	32	ounces.
Oxide of cobalt	3	„
Fragments of glass	300	pounds.

The well-known property of borax, as a powerful flux, has occasioned the suggestion that, by its means, glass made with potash might be caused to flow in fusion as freely as that wherein soda is employed.

Great care is required in mixing the materials; much more, indeed, than is necessary with other kinds of glass. The sand, lime, soda, and manganese, being properly intermingled, are sometimes *fritted* in small furnaces, wherein the temperature is gradually raised to a full red, or even to a white heat, at which point it is maintained, and the materials are carefully stirred, until vapour is no longer given off, and no further change is undergone by the materials. This process of fritting lasts about six hours, and when it is nearly completed, the remaining part of the ingredients, consisting of the cobalt and broken glass, is added. The latter, having already been perfectly vitrified, does not, consequently, require any lengthened exposure to the fire. Fritting is now, in many manufactories, omitted, the material being placed at once in the large pots, small quantities at a time.

From the time of filling the pots, nearly forty hours' exposure to strong heat is necessary before the materials are properly vitrified and in a fit state for casting. When the melted glass in the cuvette is found to be in the exact state that experience has pointed out as being most favourable for its flowing readily and equably, this vessel is withdrawn from the furnace by means of a crane, and is placed upon a low carriage, in order to its removal to the casting table, which as it is previously placed contiguous to the annealing oven that is to be filled, may therefore be at a considerable distance from the melting furnace. Measures are then taken for cleaning the exterior of the crucible, and for carefully removing with a broad copper sabre any scum that may have formed upon the surface of the glass, as the mixture of any of these foreign matters would infallibly spoil the beauty of the plate. These done, the cuvette is wound up to a sufficient height by a crane, and then, by means of another simple piece of mechanism, is swung over the upper end of the casting table, and being thrown into an inclined position, a torrent of melted glass is suddenly poured out on the surface of the table, which must previously have been heated and wiped perfectly clean.

The glass is prevented from running off the sides of the table by ribs of metal, one of which is placed along the whole length of each side, their depth being the exact measure which it is desired to give to the thickness of the glass. A similar rib, attached to a cross piece, is temporarily held during the casting of the lower end of the table. When the whole contents of the crucible have been delivered, a large hollow copper cylinder, which has been made perfectly true and smooth in a turning lathe, and which extends entirely across the table, resting on the side ribs, is set in motion, and the glass, during its progress, is spread out into a sheet of uniform breadth and thickness. Its length depends upon the quantity of melted glass contained in the cuvette: should this be more than is needed for the formation of a plate having the full dimensions of the table, the metal rib is removed from its lower part, and the surplus glass is received in a vessel of water placed under the extreme end for that purpose. The plates have then to undergo all the operations of squaring, grinding, polishing, and silvering, in order to fit them for sale.

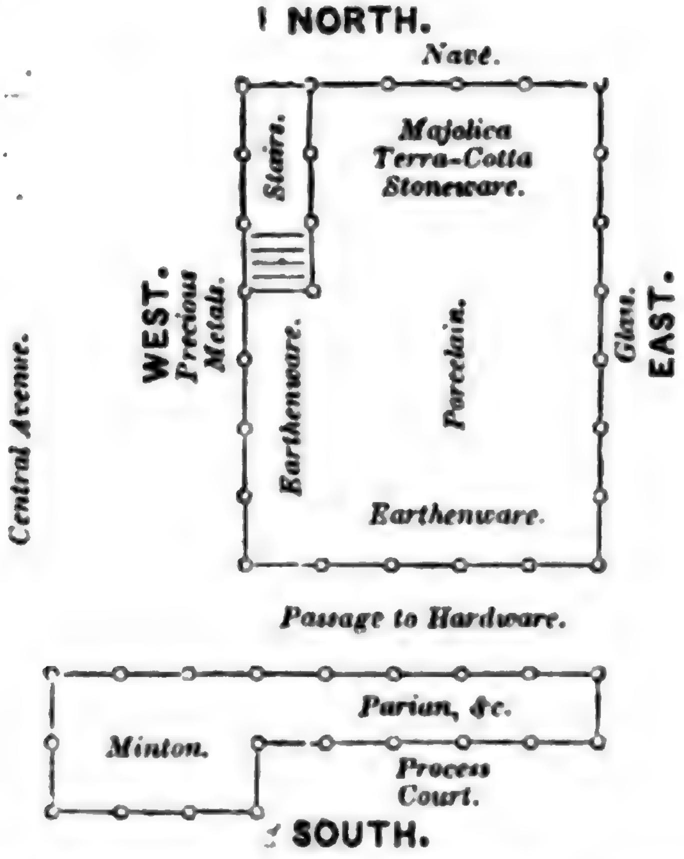
Having examined this collection, the amateur and the *expert* will be equally disposed to pronounce that a very great improvement has taken place in this manufacture.

CLASS XXXV.—POTTERY.

Number of Exhibitors, 69.

SITUATION OF CLASS IN BUILDING.—*This beautiful collection is immediately associated with Glass. It has one front on the Nave, and another on the passage which divides the Class from Hardware; with an extension behind the Precious Metals on to the Central Avenue.*

Position of Groups.—Along the Nave are arranged two cases of Wedgwood and Majolica—the Queen's Service and a Case with Mr. Copeland's manufactures being in the Nave. Sir J. Duke's Case is also in the Nave. The principal makers and dealers occupy the centre of the Court, with highly ornamented Porcelain, Statuary-Porcelain, and the like. Earthenware has its place around the Court. Minton occupies a court opening on the Central Avenue.



MATERIALS FOR POTTERY. These are exhibited chiefly in Class I., where many examples of the following clays will be found:—

Bovey Clay.—This is obtained from Bovey Heathfield, Devonshire, and is derived from the decomposition of the felspars of the great granite ranges of Dartmoor. About 20,000 tons are sent from the neighbouring parts annually. The mode of raising it is extremely simple,—the gravel head is removed, and a large rectangular pit is sunk, which is supported by wood. The workmen cut out the clay in cubical lumps weighing about 30 lbs. each, and fling them from stage to stage by means of a pointed staff; it is then carried to the clay cellars, and when properly dried, sent to the potters.

Poole Clay is so called from being shipped at Poole. It is only here necessary to state that the period of its formation is somewhat indicated by the vegetable remains which are discovered in the clay. These are parts of plants, principally of palms, maples, and such as belong to a sub-tropical climate, like that of Africa along the shores of the Mediterranean Sea.

China Clay, or Cornish Clay.—About 1755 William Cookworthy, of Plymouth, discovered that the clays of Tregoning hill, in the parish of Breage, near Helstone, Cornwall, were of the same character as specimens of Kaolin which he had seen, brought from Virginia. Associating himself in this discovery with Lord Camelford, Cookworthy worked the China clay on his lordship's property in St. Stephen's, near St. Austell. He established the porcelain manufactory at Plymouth, which was eventually removed to Bristol, and thus laid the foundation of the great advance in porcelain manufacture in this country.

Kaolin, or China Clay, is prepared chiefly in the neighbourhood of St. Austell, in Cornwall, and at Lee Moor, about five miles from Plympton, in Devonshire. The decomposed granite rock is broken out, and is commonly exposed on an inclined plane to the action of a fall of water, which washes it down to a trench, whence it is conducted to catch pits. The quartz, schorl, mica, and other minerals present, are chiefly retained in the first pit, and as the water charged with the clay flows onward it deposits the grosser particles, and eventually the pure and fine clay is deposited in tanks prepared to receive it. These tanks are about 9 or 12 inches deep, and when filled with clay, the water is turned in another direction, and the mass allowed to dry. When sufficiently consolidated, the clay is cut into oblong lumps and carried to a roofed building, through which the air can circulate freely ; in these it is dried more perfectly, and having been scraped to remove dust from the outside, it is sent to the potteries. At the Devonshire works artificial heat is applied, but in Cornwall the clay is generally dried at the natural temperature. Of late years artificial heat has been employed to dry the clay, by which process its plasticity is certainly not improved.

CHINA STONE.—This is the production of the granite rock which furnishes the Kaolin, but in a minor state of decomposition—the felspar of the compound rock still retaining much of its silicate of potash and soda.

FLINTS, as obtained from the chalk districts, are prepared by being calcined, crushed, and ground. It is said that the introduction of flints into the manufacture of pottery was by Mr. Ashbury, a Staffordshire potter, who was led to make experiments in their use from the following circumstance :—

In 1720, riding to London on business, as was then a common practice, he found, on reaching Dunstable, that his horse's eyes were disordered : he consulted the ostler at the inn, who placed a piece of flint in the fire, heated it to redness, and after throwing it into water, reduced it to powder, a little of which powder he blew into the horse's eyes. Ashbury observing the white character of the burnt flints, sent some to Shelton, where he had them burnt and powdered, and mixing the powder with pipe-clay, he first *washed* his ware with it, but ultimately introduced the flints into the body.

A considerable quantity of Chert from the limestone formations of Derbyshire and Flintshire, is also sent into the potteries. These, with calcined bones, may be regarded as the materials necessary for the labours of the potter.

In addition to the clays named above, some of the clays of the coal measures are employed. That of Stourbridge, which is remarkable for its refractory character, being used for fire-bricks, glass-house pots, gas retorts, and the like.

TERRA-COTTA.

Exhibitors.—**W. Ingham and Sons (2302), J. Woodward (2412), M. H. Blanchard (2423), J. Pulham (2441), M. Blanchard (6832), J. M. Blashfield (6833), J. Cliff and Son (6841), T. Grimsley (6857), H. Millichamp (6872), J. Roberts (6881). Also in Class X.**

This term means literally *baked clay.* It is known in the arts as the name of the ancient vases, amphoræ, pateræ, lamps, statues and bassi-relievi. Monumental vases of terra-cotta have been found in the tombs, after the lapse of 2,000 years, in a fine state of preservation. The ancient terra-cotta vases are generally painted black, on a red or buff ground; but on some there are blue, yellow, and other colours.

The merit of reviving in England the manufacture of terra-cotta belongs to Josiah Wedgewood, who in 1770 established large works in Staffordshire. About 1790 a pottery was established at Lambeth for the manufacture of decorative works; and terra-cotta was made for many years by a lady of the name of Coade, and afterwards by Coade and Sealey. The chief materials used by them were the Dorset and Devonshire clays, with fine sand, flint, and potsherds.

To explain the mode of executing any work in terra-cotta, it is best to describe the proper meaning of the words modelling, moulding, and casting.

A model is an original work made by the sculptor in clay, and worked out by the fingers and small tools made of bone and steel, varying from about 6 to 10 inches in length. This original work of the artist is allowed to dry, and then the moulding operation commences. This process is effected by mixing plaster of Paris with water to the consistency of thick cream; this is spread over the model, and when it has set it is removed in sections, which, when again carefully united, form the mould, in which either clay or metal can be cast, and receive the form of the original work. For terra-cotta work, unless many copies of the original are wanted, moulds are not employed.

When only one or two copies of a work are required, the original models are built up in a cellular manner; they are then dried and removed to a kiln and baked, being a perfectly original work.

When moulding is performed for terra-cotta works, sheets of clay are beaten on a bench to the consistency of glazier's putty, and pressed by the hand into the mould; according to the magnitude of the work and the weight it may have to sustain, the thickness of the clay is determined and arranged, and here consists a part of the art it would be impossible to describe, and which requires years of experience in such works to produce great works and fire them with certainty of success. After the moulded article has become sufficiently dry, it is conveyed to a kiln. A slow fire is first made, and quickened until the heat is sufficient to blend and partially vitrify the material of which the mass is composed; when sufficiently baked, the kiln is allowed to cool, and the terra-cotta is withdrawn.

The examples sent by Mr. Blashfield merit careful examination. The material of which they are made is peculiarly excellent, and the designs, in most instances, bear evidence of a refined taste.

The applications of terra-cotta for purposes of architectural decoration are numerous, and in many of the examples the designs are of a fine character. The mistake is, however, made by some of the manufacturers, of supposing that the material is fitted for any, even classic, forms. The application of terra-cotta in the arcades of the Horticultural Gardens is in the best taste.

MOSAIC AND OTHER TILES.

Exhibitors.—Architectural Pottery Co. (2230), T. S. Bale (2233), W. Basford (2236), R. Brown (2243), J. G. Colla (2260), J. Cowen and Co. (2265), J. and W. Eastwood (2271), C. O. Fison (2282), Garrett Bros. (2286), W. Jones (2306), R. and N. Norman (2324), T. Peake (2328), C. Maw (2317).

Also in CLASS X.

Messrs. Boote (6834), H. Cole, C.B. (6842.)

Tile manufacture is a very comprehensive term, embracing the following varieties:—Paving bricks or tiles, plain tiles, ridge tiles, oven tiles, pan tiles, circulars, foot tiles, hip tiles, drain tiles, &c.

The clay used for making tiles is purer and stronger than that used for making bricks. When the clay is too strong, that is, too adhesive, it is mixed with sand before passing it through the pug-mill. As a usual practice the clay is *weathered*; this is effected by spreading it out in layers of about two inches in thickness during the winter, and each layer is allowed the benefit of at least one night's frost before the succeeding layer is put over it. This *weathering* is sometimes effected by exposing the layers to sunshine, which is said to answer equally well with frost. What this weathering does is by no means clear: it is said "to open the pores of the clay." We believe that what really takes place is, that under the influences to which the clay is exposed, the particles break up into smaller particles, and that we have the clay in a more finely comminuted state. The next process is that of *tempering*. After the clay has been allowed to "mellow, or ripen," in pits, under water, it is passed through the pug-mill and well kneaded or tempered. It is then *slung*, that is, cut into slices with a string: during which process the stones fall out, or are removed by the hand; it is then ready for the operation of moulding. This may be performed by hand, or by any one of the many machines which have been devised.

Mr. Blashfield published a few years since an essay on Tile Manufacture, which, as it contains the best information on the subject, and is now but little known, may be quoted from liberally, and with much advantage.

About half a century since Mr. C. Wyatt obtained a patent for a mode of imitating tesselated pavements, by inlaying stone with coloured cements. Terra-cotta, inlaid with coloured cements, has also been employed, but with no very marked success.

Mr. Blashfield produced imitations of those pavements, by colouring cements with the metallic oxides: these stood exceedingly well when under cover, but they did not endure the winter frosts, &c. Bitumen, coloured with metallic oxides, was also employed by Mr. Blashfield. In 1839 Mr. Singer, of Vauxhall, introduced a mode of forming tesseræ from thin layers of clay. These were cut into the required forms, dried and baked. In 1840 Mr. Prosser, of Birmingham, discovered that if the material of porcelain (china clay) be reduced to a dry powder, and in that state be compressed between steel dies, the powder is condensed into about a fourth of its bulk, and is converted into a compact solid substance of extraordinary hardness and density.

This process was first applied to the manufacture of buttons, but was eventually taken up by Mr. Minton, and in conjunction with Mr. Blashfield, Messrs. Wyatt, Parker, and Co., was carried to a high degree of perfection for making tesseræ.

The new process, invented by Mr. Prosser, avoided the difficulty altogether of using wet clay.

This change in the order of the potter's operations, although very simple in idea (and a sufficiently obvious result of reflection on the difficulties attending the usual course of procedure), has nevertheless required a long series of careful experiments to find out the means of rendering it available in practice.

The power which the hand of the potter has exercised over his clay has been proverbial from time immemorial, but it is limited to clay in its moist or plastic state; and clay in its powdered state is an untractable material, requiring very exact and powerful machinery to be substituted for the hand of the potter; in order, by great pressure, to obtain the requisite cohesion of the particles of clay.

In the new process, the clay, or earthy material, after being prepared in the usual manner, and brought to the plastic state, as above described (except that no kneading or tempering is requisite), is formed into lumps, which are dried until the water is evaporated from the clay.

The lumps of dried clay are then broken into pieces, small enough to be ground by a suitable mill into a state of powder, which is afterwards sifted, in order to separate all coarse grains and obtain a fine powder, which it is desirable should consist of particles of uniform size as nearly as can be obtained. The powder, so prepared, is the state in which the clay is ready for being moulded into the form of the intended article by the new process.

The machine, which is one of great ingenuity, cannot be described without the aid of a drawing. It will, however, suffice that we say, that by the enormous pressure which is applied, the particles of clay comprising the tile are forced within the limits of cohesive force, and thus held firmly together. This cohesion is still further secured by the subsequent firing to which the compressed clay is exposed.

The tiles and tesseræ exhibited by Minton and Co.—those displayed in the Salopian Court in Class X., where, under the superintendence of Mr. Maw, the works of the Shropshire potters are pleasingly grouped together, and the several exhibitors, named above, will fully exemplify the manufacture of tiles and tesseræ.

These remarks cannot be closed without noticing the proposition which originates with Mr. Henry Cole for decorating buildings with Mosaics, of which, as examples of the effect, two designs are exhibited on the Cromwell Road front of the Exhibition building. Without expressing any opinion on the general effect of such pictorial embellishment for exteriors in this country, the attention of the public is directed to the idea, and the examples in illustration.

Under a committee of management, formed by the Marquis of Salisbury, Mr. Layard, and Mr. H. Cole, it is proposed to raise sufficient funds to execute two large mosaic pictures, 23 feet high, by 13 feet wide, as experiments for decorating the panels of the outside walls of the permanent Picture Galleries for International Exhibitions in Cromwell Road, South Kensington. The mosaics will be made of pottery, in geometric forms, by the pressure of dry powder. Various experiments in laying the mosaics, by Messrs. Minton, Stoke-upon-Trent, and by Messrs. W. B. Simpson and Son, of West Strand, prove that Mosaic pictures may be as easily worked and used in England as in ancient Greece and Rome or Mediæval Italy. They will be as imperishable as the hardest and most perfect terra-cottas. Herein is a new branch of industry which may be worked in any locality. The designs will illustrate Industry, Science, and Art. Some cartoons have been already prepared by Mr. Cope, R.A., Mr. J. C. Hook, R.A., Mr. Godfrey Sykes, and Mr. Townroe; two of these will be executed in mosaics as soon as the funds are provided. The ornamental borders will be designed and the mosaics worked out under the superintendence of Mr. Godfrey Sykes and his assistants. When two panels have been done and all the necessary arrangements have been made, after the close of the Exhibition of 1862, for filling the others, designs for other subjects will be sought for.

Of the bricks exhibited, but little need be said. The fire-bricks of Stourbridge are usually regarded as the more refractory, and hence they are used extensively in all our furnaces. Fire-bricks have of late years been made at Lee Moor, or Dartmoor, from the refuse matter of the China Clay Works. This consists of mica and quartz, with a little clay. Some of these bricks are exhibited in Class I. by the Lee Moor Clay Company. These bricks are of remarkable quality, and in the gas-works they have been proved to stand the most intense heats without undergoing fusion.

STONEWARE.

Exhibitors.—**J. Bourne and Son (6835), Doulton and Watts (6849), J. Dudson (5850), G. Jennings (6862), Mid-Lothian Pottery Co. (6870), W. Powell and Sons (6878), C. and J. R. Price (6879), Ynismedew Brick and Pipe Co. (6895).**

DRAIN AND SANITARY PIPES.

Exhibitors.—**Beart's Patent Brick Co. (2237), E. Brooke (2241), H. Doulton and Co. (2268), E. B. Beaumont (2371), Bourne Valley Pottery Co. (2373), Burton and Waller (2375), J. Cliff and Co. (2378), J. Woodward (2412).**

Stoneware is a dense and highly-vitrified material, impervious to the action of acids, and of peculiar strength.

The process of manufacture is as follows:—The clay used is found near the coast in Devonshire and Dorsetshire: it is dug in square lumps of about 40 lbs. each, and transported to London in coasting vessels. When received by the potter they are, after being perfectly dried, ground to a powder, mixed with water, and, after being allowed sufficient time to become of uniform consistency, the mass is passed through pug-mills, and is then fit for the operation of the workmen.

For making large vessels it is necessary to introduce into the composition portions of the burnt material, finely ground; also some of the white sand found in the neighbourhood of Woolwich and Reigate.

Almost all round vessels are formed entirely by the hands of the potter on wheels, turning at a rate decreasing in rapidity in proportion to the size of the article to be made. Vessels of other shapes are cast in plaster-of-Paris moulds. The composition is laid in them in a soft and plastic state: the porous plaster gradually absorbs the moisture from the clay, till in a short time it is sufficiently firm to be removed from the mould, which is again filled. Some thousand articles are frequently made from one mould before it is destroyed.

When thoroughly dry the ware is placed in ovens or kilns constructed for the purpose, and exposed to a gradually increasing heat, so intense as to become, before finishing, quite white; salt is then thrown in, and, being decomposed, the fumes act chemically on the surface of the ware, and fuse the particles together, giving the glaze so well known. Stoneware differs from all other kinds of glazed earthenware in this important respect, that the glazing is the actual material itself fused together; in other kinds of ware it is a composition in which the vessel is dipped while in what the potters call *biscuit*, or half-burnt state. The heat to which stoneware is exposed is so intense, that if a piece of iron or steel should by any accident be left in the kiln amongst the ware, it is entirely destroyed, being oxidized, and the oxide to a great extent volatilized.

The chemical apparatus of various kinds may be regarded as amongst the most remarkable things in stoneware. Many of the articles are of such a size as would have been considered hopeless a few years since.

The drain pipes exhibited in this Class and Class X. are, many of them, no less remarkable.

EARTHENWARE.

Exhibitors.—G. L. Ashworth and Brothers (6827), C. Bullock (6840), R. Comer (6843), J. Dimmock and Co. (6848), T. Fell and Co. (6852), W. T. Holland (6858), J. Jamieson and Co. (6861), Liddle, Elliot and Son (6866), Livesley, Powell and Co. (6867), J. Lockett (6868), J. Millar and Co. (6871), W. Northern (6874), Old Hall Earthenware Co. (6875), Sharpe Brothers (6883), H. Sherwin (6885), Wathen and Lichfield (6892), Mrs. J. Robertson (6896), M. L. Brown (6836), W. Brown (6337), W. Brownfield (6839).

Common earthenware is distinguished by its complete opacity; and, from its containing undecomposed carbonate of lime in the burnt mass, it is often, in its unglazed state, found to effervesce with acids. We confine the term earthenware, in this instance, to the white ware, employed as common dinner sets, &c., reserving our notice of the Majolica ware, &c., until we notice the tessera and terra-cotta, found also in the section devoted to mineral manufacture. The following is given as the practical formula for ordinary earthenware:—

6 barrowsful of brick clay;
4 barrowsful of blue clay;
2 barrowsful of crackling clay;
8 barrowsful of the above in "slip," *i.e.* ground into mud in water;
4 barrowsful of Cornwall clay;
7 barrowsful of flint;
1½ barrowsful of Cornish stone.

The earthenware is usually glazed with some such composition as the following:—

Decomposed granite - - -	25 parts.
Carbonate of lime - - -	3 ,,
Flint - - - - - -	10 ,,
Litharge - - - - -	46 ,,
Borax - - - - - -	16 ,,

The ingredients are all ground together in glaze mills, and the glaze is used sometimes in a liquid state, and sometimes in powder.

Printing on Earthenware.—To Dr. Wade appears to be due the idea of printing upon earthenware, the transferring of printed patterns to biscuit ware, as now usually adopted. From a mug executed by Dr. Wade, in the Museum of Practical Geology, decorated with a portrait of Frederick the Great, the date of this process appears to be 1757.

It is a process of much interest. A printing-ink of the desired colour—cobalt blue, manganese black, or chromium green, is mixed with linseed-oil varnish, and the copper-plate impression is printed with this ink upon thin paper in the usual manner. This print is carefully placed on the porous *biscuit*, with the printed surface towards the earthenware, and the article to which it is applied is dipped into water. By this the paper is softened, and can be brushed away, while the coloured varnish ink, which is not affected by water remains as a picture upon the ware. The varnish of the ink is destroyed by heat: this is called "hardening;" it is then glazed, and the designs finally burnt in.

Stone-china is a somewhat recent introduction. This consists in producing a very fine body by the use of larger quantities than usual of the Cornish china-clay, and in the employment of the harder glazes made from the china-stone.

Many remarkably fine examples of earthenware are exhibited, the colour being very pure, and the decoration chaste.

PARIAN, OR STATUARY PORCELAIN.

Exhibitors.—**Battam and Son (6829), Brown, Westhead, Moore and Co. (6833), Crystal Palace Art Union (6845), W. H. Goss (6855), Keys and Briggs (6864), Livesley, Powell and Co. (6867), G. Meli (6869), E. Temple (6890), Turner, Bromley and Hassall (6891), Davenport, Banks and Co. (6847).**

The first idea of imitating marble in ceramic manufacture originated with Mr. Thomas Battam, the artist directing the extensive porcelain manufactory of Mr. Alderman Copeland, at Stoke-upon-Trent, in the commencement of 1842. After a series of experiments he succeeded in producing a very perfect imitation of marble, both in surface and tint. One of the earliest specimens was submitted to His Grace the Duke of Sutherland, who expressed his unqualified admiration of the material, and his high appreciation of the purposes to which it was being applied, and became its first patron by purchasing the example submitted. This was on the 3rd of August, 1842, a date which marks a memorable event, as the commencement of a trade now not only of large commercial advantage to the potteries generally, but fortunately of a class that has most materially advanced the artistic state of English ceramic manufacture. Some groups of Graces and Satyrs for Kaneophoroi, and also large Caryatides for fireplaces, and a variety of garden vases and brackets, were executed. In 1843, amongst other works, the equestrian statuette of Emanuel Philibert, by the Baron Marochetti, was produced; also the Warwick Vase of a large size; and other large vases for conservatory purposes. It was also introduced, in conjunction with coloured and gilt decoration, on ornamental pillars and vases; a copy (reduced size) of the beautiful statuette of the "Goatherd," by the late S. P. Wyatt, R.A., from the marble in the possession of the Duke of Sutherland, was also executed. Its operations were comparatively confined until 1844, when it was seen by Mr. Gibson, R.A. That eminent sculptor at once declared it to be "the best material next to marble," and also expressed his desire to see one of his own works produced on it.

The production of the statuettes, vases, &c., exhibited in this material involves the following manipulatory details:— The material is used in a liquid state, technically termed "slip," about the consistency of thick cream. It is poured into the moulds forming the figure or group, which being made of plaster, rapidly absorbs a portion of the moisture, and the coating immediately next the mould soon becomes of a sufficient thickness for the cast, when the superfluous "slip" is poured back. The cast remains in the moulds for some time at a high temperature, by which it is (through the evaporation that has taken place) reduced to a state of clay, and sufficiently firm to bear its own weight when relieved from the moulds, which are then opened, and the different portions of the subject taken out. Each figure requires many moulds; the head, arms and hands, legs, body, parts of the drapery, when introduced, and the other details of the subject, are generally moulded separately. This is a process requiring, when well executed, the greatest nicety and judgment, the fragile nature of the material in its present state rendering considerable practical knowledge necessary to form a perfect union of the different members, and also that they are so disposed as to be in strict accordance with the original model; for, though made from the same moulds, it by no means follows that all the casts will possess equal merit, so much depending upon the taste and skill of the finisher,—the figure-maker. Peculiar care is required in putting together nude figures, in which the junction of the parts, generally presenting a level circular surface, requires the decision of an educated eye to fix with accuracy. Surfaces that possess a marked and broken outline, which will only fit together at one particular point, are, of course, exempt from this difficulty. Want of judgment in this respect will often cause such a deviation of outline, as seriously to injure the beauty of the work. The parts are attached together by a "slip," similar to that used for casting, the surfaces to be joined together being either dipped into it, or the "slip" is applied with a pencil; and according to the discretion with which this is executed, and the neatness with which the sections of the moulds are made to fit, will be the greater or less prominence of the seams which so often disfigure pottery castings. It is possible, with care, that these seams shall be so trifling as to be scarcely perceptible, even upon a close examination; and it is only the want of proper precaution, that the contrary is too often the rule instead of the exception. The "slip" in this case is merely required to soften the surface of the clay of the members which have to be united, just sufficiently to cause adhesion. All that is used beyond that requirement is not only superfluous, but actually detrimental; moistening the part to which it is applied so much that the edges become pliant, and yielding to the pressure while being attached, distort the outline, and by causing unequal shrinking in the process of firing, the junctures become evident and unsightly. This fact cannot be too forcibly impressed upon those engaged in this branch of the art, as it is of the greatest importance to their interests, for exactly in proportion to the beauty and perfection to which these objects are produced, will this novel and valuable introduction merit and obtain success.

The figure or group being thus put together remains two or three days, when, being sufficiently dry, it is supported by "props" made of the same material, placed in such positions as to bear a portion of the weight, and prevent any undue pressure that might cause the figure to sink or yield in the "firing." Each end of the "prop" is imbedded in a coating of ground flint, to prevent adhesion, and is thus easily removed. It is then placed in the oven, and submitted to a heat of about 60° of Wedgwood's pyrometer. This operation, which is gradually effected, occupies from 60 to 70 hours. The fires are then withdrawn and the oven allowed to cool; and when sufficiently so, the figures are drawn out, and the seams rubbed down; they are again placed in "saggers" and imbedded in sand, and then re-fired at a still higher temperature than they were previously submitted to. The bedding of sand is preferred in this part of the process to "props," as it more equally and effectually supports the figure. It could not be used in the first instance when the figure is in the clay, as by resisting the contraction, it would cause it to be shattered to pieces; it is even sometimes necessary to *fire* casts three times, a peculiar degree of heat being required to produce the extreme beauty of surface which the finest specimens present. The total contraction of the figures from the mould to the finished state is one-fourth; the contraction of the "slip," with which the mould is first charged, to the state in which it leaves the mould, is one-sixteenth; again, it contracts another sixteenth in the process of drying for the oven, and one-eighth in the process of vitrification—so that a model 2 feet high will produce a fired cast of 18 inches only. Mr. Minton states the contraction of their improved composition as being but little more than one-fifth.]

After a very careful examination of the Parian figures exhibited, the conviction becomes stronger that less care is taken in their production, than distinguished the works exhibited in 1851. In many examples this want of attention to the delicacy of outline has produced forms which are in many respects offensive. Of course, from this censure many examples must be excepted; the selection made by the Crystal Palace Art Union is admirable, and the mention of several exhibitors who have specimens of great beauty is avoided, to prevent any feeling that partiality has been shown. It is preferred that the public should be their own judges.

PORCELAIN.—*Introductory.*

True porcelain is of comparatively recent introduction in this country; the discovery of the value of the Cornish china-clay at the latter end of the last century by Mr. Cookworthy, of Plymouth, being the commencement of this manufacture. It is composed of an infusible china-clay and a fusible flux. The body formed by the kaolin, or china-clay, alone would be found to be an exceedingly porous one; but the flux which is composed of felspar, quartz, and gypsum, is melted in the heat of the porcelain furnace, and completely filling all the pores of the clay, binds the whole into a firm mass.

Microscopic examination shows that porcelain consists of small opaque particles, arranging themselves in linear directions, while the transparent flux has interfused itself through the whole mass. The chemical composition of it is—

Silica - - -	58	grains.
Alumina - -	35	„
Lime - - -	5	„
Potash - - -	2	„

The glaze for English porcelain is formed from the china-stone of Cornwall, which is a peculiar variety of decomposed granite, the mean composition of it being—

Silica	**73 grains.**
Alumina	**18 „**
Potash	**9 „**

The advances which have been made in the manufacture of porcelain are great. We were entirely dependent upon the manufactories of the Continent, particularly of Berlin, for a variety of hard porcelain, which is used for chemical purposes. We can now produce an article in every way equal to the Berlin ware. Since it is impossible to describe in detail the varieties of ornament introduced by our potters, either in the way of painting or gilding, we can only select the greatest novelties.

The caprices of fashion are of the most curious character. We find that which one age rejects as barbarous, is received in another age as the pattern of beauty. Each conclusion is probably equally wrong. There is no standard of beauty to which men can appeal, and consequently false standards are continually being reared, and some of these, for a time, enjoy the advantages of a numerous following.

There has been of late a tendency to copy with all servility the fictile productions of the Italian school, and of this we have numerous examples in the present Exhibition. There will necessarily be a large number of visitors to whom the terms Majolica, Palissy ware, Meissen pottery, the Renaissance style, &c., will not prove very intelligible. For such, the following information is given:—

MAJOLICA, OR RAFFAELLE WARE.—The Moorish ware was first introduced into Majorca, and from thence it spread over Italy, under the name, derived from this island, *Majolica*. It has been called *Raffaelle ware* from the fact of some of the designs of that painter having been employed: many of them are by artists of his school, but Raffaelle, writing to the Duchess of Urbino, informs her that the designs are ready which she had desired for porcelain for her sideboard, thus proving that some of them, at least, are by that great painter's own hand. This ware was most extensively manufactured from 1540 to 1560. It was especially patronized by the Dukes of Urbino, whose arms are on the rim of one of the specimens (Vi. 60); but Duke Francesco Maria II. being overwhelmed with debt, dismissed his best artists, and consequently the ruin of the manufacture followed. The chief point to be observed in the Majolica is, that the body or paste was first fired, and then by immersion covered by a composition of oxide of lead, oxide of tin, and white earth, the tin being increased as the enamel was required to be white and hard, and then fixed a second time. The merit of the Majolica is that of making with a bad material, by the aid of an enamel glaze, a really fine-looking ware. The decoration of this ware was committed to artists who had learnt to draw in the best school of art which Europe ever produced. Any imitation in this direction would be commendable, but the attempt to return to the use of a bad material, when England possessed such clays as Italy never saw, is not an advance.

PALISSY WARE.—Palissy, of Saintes, was in every respect an extraordinary man. He was born in 1509, at Chapelle Biron, a poor hamlet near the small town of Biron in Perigord, but politically situated in the diocese of Agen. He was educated a glass painter. He writes of himself in *L'Art de Terre*, "I for a long time practised glass painting until I was assured that I could earn bread by labour on earth." Some accidental circumstance directed his attention to pottery, and he was seized with an earnest desire to discover an enamel for a clay body which should equal anything which had been produced. Not knowing what had been done by others, he with the utmost enthusiasm proceeded in his inquiry. Bernard Palissy, speaking of his experiments, says, "Having blundered several times at great expense, and through much labour, I was every day pounding and grinding new materials and constructing new furnaces, which cost much money, and consumed my wood and my time." Again he says, "I fooled away several years with sorrow and sighs, lessening the bread of my children and weighed down by domestic cares." Eventually success crowned his endeavours, and the works of Palissy the potter became famous.

MEDIÆVAL POTTERY embraces the period known as the Renaissance (literally meaning *a new birth*). Leo X. made some discoveries of paintings in the Thermæ of Titus; these were studied by Raffaelle, and on them he based a new style of decoration, freer than the antique, but still partaking in many respects of its character. This is the Renaissance Style. The term is very often most loosely applied.

Lucca della Robbia, who was celebrated for his terra-cotta figures and bas-reliefs covered with a stanniferous glaze, also made enamelled tiles, which he introduced into the church at Pisa about 1415-20.

MEISSEN PORCELAIN, or *Böttcher Ware.*—Böttcher, in the commencement of the 18th century, made the earliest specimens of true porcelain in Europe. He first worked at Dresden with a brown clay, found near Meissen, and produced a red ware, and in 1709 he made white porcelain. Augustus II., elector of Saxony, and king of Poland, established porcelain works at Meissen, and Böttcher was appointed director in 1710. In 1715 he succeeded in making fine and excellent porcelain. This manufactory has continued to the present day, producing that superior porcelain commonly known as Dresden China. There is a curious story connected with this manufacture. John Schnorr, an iron-master, residing near Aue, observed that a soft white earth adhered to his horse's feet; considering that this earth might be used as a substitute for wheat flour as hair powder, he carried some away with him, and it was subsequently sold in large quantities for this purpose at Dresden, being known as *Schnorrische weisse Erde* (Schnorr's white earth). Böttcher, finding his hair powder was heavier than usual, was induced to examine it, and this led to the discovery of the use of Kaolin in porcelain at Meissen, where its employment was long kept a profound secret. The establishment at the Albrechtsburg was a complete fortress for the confinement of the people employed, and "Be secret unto death" was placed on the walls of the workshops. The specimen of Böttcher ware exhibited was produced in 1796.

From Meissen, however, the secret of the manufacture of porcelain spread, and Berlin, Munich, and St. Petersburg, about the middle of the 18th century, boasted of their potteries. The Sèvres works were established at St. Cloud before 1695, but it was not until about 1769 that the use of Kaolin was introduced, it having being then recently discovered at St. Yrieix, near Limoges.

Of these several examples, or rather copies, appear in the different collections.

Etruscan Vases are also imitated by a few; and there are several attempts to produce imitations of the enamels of Limoges or Porcelain.

Delf Ware has one or two copyists. The manufacture of the famous Delf Ware was established about the commencement of the 17th century, and for a long period was much esteemed in this country. The composition of four of the most important of the wares named, proves very similar. Brongniart gives the result of his analyses as follows:—

	Silica.	Alumina.	Lime.	Manganese.	Iron.	Carbonic Acid, &c.
Lucca della Robia - -	49·65	15·20	22·40	0·17	3·70	8·58
Majolica - - - - - -	48·00	17·50	20·12	1·17	3·75	9·46
Delf - - - - - - -	49·07	16·19	18·01	0·82	2·82	13·09
Palissy - - - - - -	67·50	28·51	1·52	..	2·05	..

The marked difference between the Palissy and the other wares is the increased quantity of silica, and the exceedingly small proportion of lime.

Majolica is an earthenware, but it takes its place so prominently with the porcelain groups, that it is mentioned with them. The most remarkable example is in the centre of the Dais under the Eastern Dome, this is the ST. GEORGE'S FOUNTAIN, executed by Minton and Co. It stands 36 feet high, and is 39 feet in diameter. It was designed and modelled by the late Mr. John Thomas, whose conceptions, to their minutest details, have been admirably carried out. Four winged figures of Victory, holding crowns of laurel, encircle a central pavilion, on the top of which rests the group of St. George and the Dragon. Underneath are a series of smaller fountains, one of which, the Stork, was originally modelled by Mr. Thomas for the Queen's dairy, at Windsor, under the personal superintendence of his Royal Highness the late lamented Prince Consort.

We now proceed to Messrs. Minton's Ceramic Court, and invite especially the connoisseur and collector of pottery to accompany us, assuring them that here is ample store for a rich treat. Before entering, however, it will be well to take a cursory view of the exterior; and here we find displayed a great variety of glazed tiles in enamel colours, from designs by the best architects and artists; especially some fine gothic ones by the late Welby Pugin. These are ornamented by a patent process similar to the block-printing for illustrating books; and by this process the most elaborate patterns, which otherwise could only be produced at great cost, can be brought within a moderate price.

At the principal entrance of the court are placed two candelabra, 9 feet high, and carrying ten globes or burners. They are of Palissy ware, in the Greek style, and are extremely effective. In the large glass cases at the four corners of the court, are deposited the choicest examples in porcelain and Parian. The collection of vases is large and extremely varied in style and decoration. These were intended to prove, and do so most fully, how great the progress and improvements which have been effected by Minton and Co., since the Exhibitions of 1851 and 1855. These gentlemen, after long experience and successive improvements, are now able to produce the old Sèvres colours, Rose du Barry, Turquoise, and Bleu de Roi, as fine as any ever in use at the royal establishment.

PORCELAIN.

Exhibitors.—J. and M. Bell and Co. (6830), Messrs. Bevington and Son (6831), W. T. Copeland (6844), Sir J. Duke and Nephews (6851), J. Goode and Co. (6853), G. Granger and Co. (6856), W. H. Kerr and Co. (6863), Minton and Co. (6873), W. P. and G. Phillips (6877), Rose and Co., Daniell and Co. (6882), J. Sharpus and Cullum (6884), Story and Son (6889), J. Wedgwood and Son (6893), Wilkinson, Rickhuss and Badock (6894).

Minton and Co. have for a long period been celebrated for their reproduction of ancient and foreign pottery, and on this occasion they afford no ordinary degree of interest, by exhibiting specimens of different kinds of pottery that have never before been produced in this country. Amongst these specimens are a pair of oval jardinières, painted from the Boucher pictures in the Louvre; and a pair of vases, with groups of Muses after Lesueur. These show immense improvement in the painting of figure subjects. Ample attention has been paid also to the department of dessert services of a highly artistic description. There is a set of five ornaments, composed of a centre piece, formed of four Caryatides supporting a large basket; cameos are painted in the cornices, and the base has painted bas-reliefs. The four baskets for the corners of the table are supported by Cupids holding festoons of flowers, and in the centre of the baskets a figure representing each of the seasons rises conspicuously; the exterior of the basket is painted with cameos alternating with flowers. This is a most original composition. There is a large collection of dessert plates, in which the style called Louis the XVI. chiefly prevails.

We must not omit to call attention to the Chinese lanterns, of which there are two specimens, one in green and the other in pink and gold. They are of octagonal form, the decoration perfect, and those who carefully examine the delicately-perforated parts, will not be surprised to hear that even the practical potter is astonished at the difficulties that have been overcome in the manipulation and the fixing of such gems of art. A pair of large vases, supported by a group of fair

Cupids in Parian, will arrest attention. These are each no less than 6 feet 3 inches in circumference—by far the largest pieces of china ever manufactured in England. The Cupid supports are most beautifully modelled. The colour of the ground is dark blue, and a wreath of roses in a bold style is painted on the body of the vases. The handles are formed of large snakes in gold, spiritedly and naturally moulded.

There are numerous specimens of an ingenious invention, by which porphyry and malachite have been successfully imitated. We may mention a pair of vases on triangular pedestals, 5 feet high, in which the porpyhry forming the body is enriched with ornaments of gold and white enamel, as most effective specimens.

The numerous specimens of Majolica form a striking part of the collection. These are manufactured of native Staffordshire clays, coated with opaque and transparent enamel. Some of them are original compositions, and others either copies from old pieces or modern adaptations. A series of five large dishes represents the triumph of Julius Cæsar. These are from the Cartoons of Mantegna, at Hampton Court Palace. We may mention, too, a pair of magnificent vases, supported by four Cupids, with festoons of fruits hanging from the handles, which are formed of the ram's head; these, in particular, prove the success of the firm in perfecting the great variety of the coloured glazes they use. There is a series of jardinières, in a variety of forms, some shaped with a Cupid holding up a basket, surrounded with a wreath of daisies; others with an architectural support, the basin at the top being surrounded with alternate wreaths of lemon and fir cones, in the Lucca della Robia style. A large fountain, modelled from a sketch furnished by Lady Marian Alford, of which three young Tritons riding on a dolphin, form the support, the outer rim of the basin being ornamented with a wreath of flowers intersected with shells and corals, is altogether a fine work. Two enormous bowls on pedestals, Indian shape, should not be passed over; they are intended to hold a large number of plants or flowers. These and other specimens show the complete mastery that has been achieved in the manipulation of works that a comparatively few years ago would have been deemed impossible of attainment in this country. A dessert service in the Palissy style of enamelling is admirable in conception and execution. The wine-cooler, the most striking object of the service, has four hunting groups arranged round the base; the body being ornamented with heads of wolves and bears, as also with spirited bas-reliefs representing a bear-hunt, and on the top is a group of children on each side a small barrel. This is a fine piece of modelling.

There are specimens of a very thin and delicate sort of porcelain closely resembling the Japanese porcelain so long celebrated. These are the first samples of the kind produced at an English Pottery.

Messrs. Copeland have an important collection, including illustrations in all the principal classes of Ceramic Art, displayed in three localities in the building, comprising examples of Ceramic statuary, viz., statuettes, busts, &c., from original models expressly executed by J. Gibson, R.A., W. C. Marshall, R.A., F. H. Foley, R.A., Baron Marochetti, A.R.A., R. Monti, J. Noble, S. Durham, W. Theed, F. M. Miller, Marshall Woods, &c. Also porcelain vases of large dimensions, with floral decorations; also a series with figures and landscapes; a dessert service executed in porcelain; and statuary with pictorial illustrations of "the rivers of France," from the original pictures by E. M. W. Turner, R.A.

Examples of the Limoges style of enamelling adapted to porcelain, as well as that of the costly jewelled ware, are presented, and richly-decorated specimens of English egg-shell porcelain.

A remarkable feature amongst those exhibited is the introduction of a new process in imitation of marble, exemplified in statuettes, busts, &c. The contraction of the Ceramic statuary, Parian, &c., now so much in use, is nearly *one-fourth* in the drying and firing, subjecting the work to the risk of unequal shrinkage, and consequently liability to distortion of outline, unless great experience and artistic knowledge be brought to the task, and even then the results are not such as to satisfy altogether the requirements of an educated eye. This new material shrinks but *one-seventeenth*, therefore almost insuring a work as perfect as the model. Many works of very large size are exhibited, illustrating this important process.

J. Wedgwood and Sons occupy two spaces along the Nave, with, as the Catalogue tells us, "various descriptions of wares and vases." The name of Wedgwood is a classic one in the Ceramic Art. Of him M. Arnoux says:—"It is not only that Nature, when she gave the English people commercial and industrial genius, gave them also a soil richly supplied with the best materials for this manufacture, but it is to the exertions of some men of genius that England is indebted for this result; and *I think it only just to consider Wedgwood as the man who has given to the English Ceramic Art the powerful impulse it has preserved up to the present time.*" Wedgwood was born in August, 1730, and as a boy worked in a small pottery belonging to his father, as a *thrower*. In 1759 he commenced for himself in a humble way, manufacturing small ornamental articles. He very much improved the *Cream Ware* of the time, first made by Mr. Wood, and having introduced it to Queen Charlotte, he received permission to call his manufacture *Queen's Ware*. This ware and his knife handles must be regarded as the foundation of Wedgwood's fame and fortune. Associated in partnership with Mr. Bentley of London, Wedgwood succeeded in securing the assistance of artists, such as Flaxman, and the support of the patrons of art. From this time may be dated those beautiful productions which are so associated with the name of Wedgwood—vases, cameos, medallions, and the like, which have not been excelled by any manufacturer since his time.

This firm still lives upon the traditions of its founder. They display a considerable variety of vases in the well-known Wedgwood ware. Many of the designs which are now producing are those of Flaxman, and certainly there has not been anything more beautiful than those produced since his time. They have another stand devoted to Fayence, or the enamelled pottery passing under the name of Majolica. The correctness of the imitation is to be admired, and especially the metallic lustre or iridescence, which was the distinguishing feature of some of these wares, peculiarly so that produced by Maestro Giorgio, who was one of the most esteemed of the early Ceramic artists. These modern examples should be carefully studied—as should also a beautiful piece in terra-cotta representing a Bacchante and a Satyr.

Sir James Duke and Nephews are exhibitors of many beautiful things, Majolica and Palissy ware, of course, amongst them: the remarks already made in regard to those applies equally to this collection, as well as in the displays of Copeland, Kerr and Co., and others, are the Limoges enamels, imitated on porcelain.

Enamelling, or the process of covering metals or stones with a vitreous substance, or of running enamels into portions which have been previously removed by a graver, is of high antiquity. There was but a step from the enamelled bricks of Babylon to the enamelled bronzes of the Romans, or the shrine enamels of the Byzantine empire.

Enamel painting—or, properly, painting on enamel—is fully illustrated in these modern productions. The white cake enamel, the beads and the pipe, were formerly manufactured in Venice. These appear to consist of about ten parts of lead and three parts of tin, converted into oxide by heat and exposure. To the mixed oxides are added ten parts of quartz and two parts of common salt, and the whole fused together. This composition, being reduced to powder, was spread over a plate of copper or gold and exposed to a strong heat; in this way the enamel is applied until a proper thickness is obtained. This is the surface upon which the enameller has to work. Instead of using metal as the base for the enameller to work on, a porcelain plate is now employed. He takes metallic oxides, these he mixes with the flux and paints his picture. An enamel painting has to pass many times through the fire, consequently great care is required in this part of the work.

No fault can be corrected, the fire fixes the colours as applied, and whether good or bad they are unchangeable.

Limoges has affixed its name to a peculiar variety of enamels, owing to the great attention paid to the work in that district, where for a long period a large manufacture of shrines and reliquaries was carried forward. These shrines or reliquaries were in common use, and were usually decorated with some legend of the saint to whom they were dedicated. In the 14th century the Limoges enamels of Joseph Lanon were in great request.

Many of the productions of this class are of great beauty. The designs are chiefly copies from the works of artists whose names are engraved on the records of fame.

Rose and Company, associated with Daniell and Company, display some of the most beautiful productions in porcelains which are to be found in the Exhibition. Recently Mr. Llewellyn Jewitt has written so well on the Coalport Porcelain works, in the 'Art Journal,' that it is not possible to improve upon his remarks. We have not space for his interesting historical remarks; we therefore take his notices only where they immediately concern the present establishment.

"In 1820 Mr. John Rose received the gold medal of the Society of Arts for his improvements in the manufacture of china. The prize, which was offered for the best porcelain glaze produced without lead, was competed for by Copelands, Davenports, and all the principal manufacturers, as well as by Mr. Rose, and was awarded to him. It bears the inscription—"To Mr. John Rose, MDCCCXX., for his improved glaze for porcelain."

"The porcelain trade owes much to the ability and energy of Mr. John Rose, the uncle of one of the present proprietors; and it is truly pleasant to add, that the works so ably commenced by him have been carried on with the utmost skill, and with complete success, by the nephew, Mr. W. F. Rose, who has gained most honourable distinction, at home and abroad. Both at the Great Exhibition in 1851, and at the French Exhibition in 1855, Messrs. Rose and Co. carried off medals for their productions.

"In 1845 Messrs. Daniell, of London, who with their predecessor have been connected with the Coalport works in large transactions for nearly half a century, received the Queen's commands to prepare a dessert service for the late Emperor Nicholas, which her Majesty presented to the Czar. This service was made at Coalport; the colour was "bleu de roi," with the various orders of the Russian empire enamelled in compartments around the border, and was the object of much admiration at home and in Russia.

"In 1849 Messrs. Daniell originated the idea of restoring that beautiful and celebrated colour called the "Rose Du Barry," and after numerous efforts and experiments at Coalport, it was at last produced. A magnificent dessert service was the result, which they exhibited at the Exhibition in 1851, and which was purchased from them by Lord Ashburton. It created very considerable interest, and was deemed, by competent judges, to equal the original Sèvres in beauty of tint, and to surpass it in evenness of colour. State services and other works in this colour have since been executed, after special models and designs, for the Duke of Northumberland, the Marquis of Lansdowne, Lord Wodehouse, and the Emperor of the French.

"The subject of *printing* upon porcelain is one so intimately and intricately connected with the Caughley and Coalport works, that it will be necessary to consider the period of its introduction. Transfer-printing was used as early as 1757 on Worcester porcelain; and quite as early, if not a few years before that period, it was practised at Caughley. Indeed, in the early years of the manufactory, the two works, Caughley and Worcester, seem to have been closely connected, and to have worked "in-and-in," if I may be allowed the use of so unscientific an expression; and I believe, with ample reason, that a great proportion of the printed goods bearing the Worcester mark were printed at Caughley. Indeed, it is known that the ware was sent up from Worcester by barge to be printed at Caughley, and returned, when finished, by the same mode of conveyance. I have closely examined the style of engraving, and the patterns of a large number of examples, and I am clearly of opinion that they are the work of the same hands.

"I do not, by this, claim for Caughley the honour of *inventing* the art of transfer-printing on to porcelain; but I feel assured, that that art must have been there practised at quite as early a period as the dated example of Worcester make; and I am led to this belief, partly from the fact that the artist to whom the engraving of the dated example is ascribed, also engraved for the Caughley works; and I have an impression of a plate, of an identical pattern with the famous tea group, which bears his monogram on the Worcester specimens, on which his name, *R. Hancock, fecit*, occurs in full at Caughley. Collectors, therefore, in a case of this kind must not be too hasty in ascribing, from appearance *alone*, examples to either one or the other make, but must be guided, in a great measure, by the *body* on which the engraving occurs.

"It cannot be wondered that an art, then such an important secret, should have been followed at Caughley,—a place so perfectly retired from the world, situated in the midst of woods and wilds, almost unapproachable to strangers, and with every facility for keeping the workmen away from all chance of imparting the secret to others,—in place of Worcester, where secresy would be almost impossible, and where the information would ooze out from the workmen, and be greedily caught up by those interested in the process. At Caughley every possible precaution seems to have been taken to secure secresy; and the workmen—the engravers and printers—were locked up and kept apart from every one else. Who the engravers were, I cannot satisfactorily say. Among them, however, was a man named Dyas, who was apprenticed at Caughley, about the year 1768, and who continued at the works until his death, at the ripe age of eighty-two. It is also worthy of note that Mr. Minton, the father of Mr. Herbert Minton, was also apprenticed as an engraver at these works. It is not too much to say, that the style adopted at so early a period was remarkably good, and of really high character. Indeed, some specimens which I have seen of the plates used at Caughley, are far superior to most of the productions of the period.

"Of the painters employed at Caughley, it will be sufficient to say that amongst those apprenticed there, were John Parker, Thomas Fennel, and Henry Boden, famous for their skill in flowers; and that Muss, Silk, and others, excelled in landscapes and figures—some sepia landscapes being remarkable for their pure artistic treatment; while among the gilders, a most important art, and one to which special attention has always been directed at these works, were men of the name of Rutland, Marsh, and Randall, who were considered proficients. Of the latter, a nephew, who is the author of a pleasant little volume on the "Severn Valley," is still employed at the works, principally on birds.

"The *principal* painter of the present day, though there are several other excellent ones, is Mr. Abrahams, a student of Antwerp and Paris, and a successful follower of the school of Etty. The softness of touch, the purity and delicacy of feeling, and the sunny mellowness of tone, as well as the chasteness of design and correctness of drawing, produced on the best pieces of this gentleman's productions, show him to be a thorough artist, and place him high above most others in this difficult art. Among the other painters worthy of note are Mr. Birkbeck, Mr. Rowse, and Mr. Cooke. Modellers of a very high class in their respective branches are also employed, and the excellence of their work is apparent in all the higher class productions of this establishment."

The celebrated Paul Potter's tray, and the dessert service in the same case, have been painted by Mr. Abrahams. Some vases with humming-birds, beautifully copied from Mr. Gould's large work, are fine illustrations of painting on porcelain.

Mr. Daniell, in his desire to meet the prevailing tastes, has stimulated the Coalport works to produce some vases of a mauve colour, which has been done very successfully. A beautiful set of vases, being a continuation in the best taste of porcelain and Parian, which is a present from the Duchess of Wellington to the Princess Alice, will be much admired.

Messrs Binns and Kerr of the Royal Porcelain Works, Worcester, make a very remarkable display; they have in the Nave a portion of the service which they have lately executed for her Majesty the Queen. The service is executed in enamel in monochrome, in the style of the enamels of Limoges, but on a turquoise ground. In the part executed, they have not been allowed any great scope for freedom of design in form; they have, however, introduced one novelty in the shape of the great dishes, &c., which are all turned over on the edges. This allows the ornament to be seen when the dish is dressed.

In the part of the service already executed there are eighty plates all different in design. The arrangement consists of one principal group in a panel to four subordinate ones—all having some relation to the principal one. Thus, if the chief group is a Bacchanalian subject, the others have trophies, &c., of a similar character. The grape baskets, wine coolers, compotees, &c., are all different in design, as is also the gilding on the borders of the plates.

The trades mark on the back was designed by Mr. Digby Wyatt, and contains the principal names in the history of European pottery.

In other cases, in the Porcelain Court, this firm exhibits specimens of its enamels on dark blue. This is the colour on which the style was first introduced, and which was liberally patronized by her Majesty and the late Prince Consort. The remarks made on a former page on the enamel process applies equally to this very interesting collection.

They also exhibit Raffaelle porcelain, so called from the style of colouring. The treatment of the colours is something quite new in porcelain, and the peculiar one of the body has enabled them to harmonize the colours in an unusual manner. The body used is an ivory porcelain, a specialty of Worcester.

The ivory glaze has been applied by this firm to their Parian figures. It has the defect which is so sensibly felt in the tinted Venus, or indeed in any tinted marble—while you make a futile attempt to approach the real, you lose the charm which belongs to the ideal. The perforated china for which Worcester has long been celebrated is displayed here to great advantage.

The Egg-shell China, as it has been called, of the Chinese and Japanese—and of which there are exhibitors in this Court—is nothing more than a true porcelain worked very thin. This porcelain was first made for the purpose of supporting the idea promulgated by the Chinese, that their China was made of egg-shells and sea-shells mixed in given proportions, and then buried for a hundred years. Dr. Johnson derives the term porcelain from this "*pour cent années*," by which Europe was deceived for nearly two centuries.

There are several exhibitors whose works deserve especial notice, but it is here impossible. Amongst others to which attention will naturally be directed are the displays of Davenport, Banks, and Co.; W. H. Goss; Keys and Briggs; Liddle, Elliot and Son; and Wilkinson, Rickhuss and Badock.

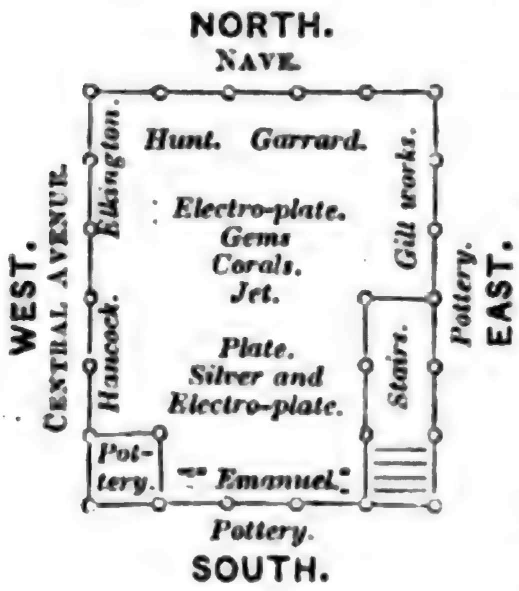
This notice cannot be concluded without expressing an opinion that the evidences of the good effects of the Schools of Design are decisive in the production of more symmetric forms, and in the arrangement of colours in the ornamentation of our porcelain and earthenware.

CLASS XXXIII.—WORKS IN PRECIOUS METALS, AND THEIR IMITATIONS, AND JEWELLERY.

Number of Exhibitors. 99.

SITUATION OF CLASS.—*At the corner of the Nave and of the Central Avenue will be found the court devoted to the Precious Metals. Pottery is to the East and South of it, divided only on the East by the stairs to the Gallery.*

Position of Groups.—The largest exhibitors are on the outside of the court: Messrs. Garrard, and Messrs. Hunt and Roskell, having their splendid cases on the side of the Nave; those of Elkington and Hancock being along the Central Avenue. In the Nave, immediately opposite the court, are the cases of H. Emanuel and of Messrs. Elkington and Co. The other portions of the court are devoted to the smaller exhibitors, and of course to a miscellaneous, although a very fine, collection.



GOLD AND SILVER.

Exhibitors.—J. Angell (6597), Atkin Brothers (6599), W. Barker (6602), Birmingham Committee (6606), W. Donne and Sons (6661), L. D. Duclos (6617), Elkington and Co. (6619), E. and E. Emanuel (6621), H. Emanuel (6622), R. and S. Garrard and Co. (6625), C. F. Hancock (6629), Hunt and Roskell (6634), Jenner and Knewstub (6636), J. Keith (6638), Lambert and Co. (6640), Miss E. La Roche (6641), London and Ryder (6648), H. Manton (6649), E. R. Payne (6657), R. Phillips (6658), J. Russell (6665), W. Spurrier (6669), Thomas (6672), J. A. Wheatley (6675), Widdowson and Veale (6676), W. E. Wiley (6677).

It is not an easy thing to make a selection from the displays of art and art manufacture, which, in every way, may be said to adorn the present Exhibition. The large exhibitors, with their massive gold and silver plate, their diamonds and other gems, attract the attention of the crowd, but there are many things far less obtrusive than those which will be admired for their simple beauty—their refined taste. It must be confessed that much that is exhibited in the precious metals is not in good taste; in many things there is a meretricious character—a want of elegance. The greater number of articles exhibited* are of a striking character, and are of the highest order as it respects workmanship. Harry Emanuel writes in the preface to his catalogue, some words of value, which show that a higher standard of taste is destined to rule the art-manufactures of England:—

"Let it be remembered, that a good model costs no more than a bad one, and that the object of a silversmith or jeweller should not be to cram as many ounces of silver or carats of diamonds into a work as possible, but to make even the commonest and most ordinary articles of a beautiful form, and no heavier than the strength requires."

Since Mr. Harry Emanuel has been quoted, his Case in the Nave may be the first to which reference should be made. Passing over the candelabrum with crystal pendants—the dessert stands representing the Seasons—we direct attention to the silver centre piece, which is to serve the purpose of a fountain. The base is square, and has four groups of boys bearing urns, from which jets of water spout out into crystal shells. At the angles are dolphins, and underneath a dome, supported by lapis lazuli and silver columns, is a miniature fountain sending its jet to the summit, and falling into an engraved basin. On the top of the dome is seated Venus, disrobed by Cupids, who, bearing her drapery aloft, support a vase for fruit or flowers. A silver ewer of very large size is a fine example of elaborate chasing. The body is divided into compartments representing the more striking points in La Motte Fouque's charming romance of 'Undine.' There are several other articles of great beauty. The gems will be noticed under their proper heads. In the case within the Court, a considerable variety of works in the precious metals will be found.

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* The word "*exhibits*" was nearly written, from the circumstance that it haunts one in everything connected with the Exhibition. Nothing can be more objectionable than such a coinage, except it be the word "*invite*" used as a substantive, "an invite," which has prevailed in London of late. In the Jury Awards this objectionable word continually occurs. Let us hope, however, that good taste will prevent our permanently departing from the principles which rule the construction of our language.

Hunt and Roskell have a case of fine examples of works in silver on the Dais under the Eastern Dome; and in a large case running along the Nave they make a remarkable display. Here are exhibited four vases, the property of her Majesty: A vase in oxydized silver, Damascened. Subject: the Centaurs and Lapithæ. On the pedestal are groups and entablatures illustrative of the same subject, and enriched by the introduction of cornelian and lapis lazuli. A vase and pedestal in oxydized silver, marine composition. The bassi-relievi represent Venus and Adonis, and Thetis presenting to her son Achilles the armour forged by Vulcan. These highly artistic and elaborate works, by Antoine Vechte, are the property of her Majesty the Queen, who has graciously permitted their exhibition. They were commanded by his late Royal Highness the Prince Consort, to whom we are so much indebted for encouragement in our endeavours to elevate the artistic character of works in silver.

Previous to the Exhibition of 1851, the Goldsmith's Company offered prizes for the best productions of art in silver. The works to which these prizes were awarded were not considered adapted to the tables of the Company, neither did they mark the state of art of the period. They therefore voted the sum of 5000*l* to be expended in works in silver for their tables, open to competition for designs, &c., to all goldsmiths, and this resulted in the selection of the following three candelabra, and two groups. These are intended to represent in the more prominent features—1. The granting of the charter to the Goldsmiths' Company by Richard II, A.D. 1392; 2. Michael Angelo in the studio of his master, Domenico Ghirlandaio; 3. Benvenuto Cellini, George Heriot, and Sir

Martin Bowes; 4. A group in silver, illustrating the business duties of the Goldsmith's Company; on the summit a figure of Science, her hand resting on a crucible, points to Law upheld by Justice, in allusion to the regulation of the standard of the precious metals. On the left a figure of Industry, with beehive and specimens of the craft; Mercury, as Commerce; Plutus, the God of Wealth. 5. A group in silver, illustrating the benevolence of the Goldsmith's Company. On the summit is a figure of Prudence, and by her side Benevolence distributing to the necessitous from the Horn of Plenty.

It is not possible to name, even, the numerous testimonials which are exhibited by this firm, the latest being the testimonial to Mr. Charles Kean. The character of all works of this kind from Hunt and Roskell's workshops is well known. Two works must, however, be noticed more at length.

The first, the shield by Antoine Vechte, was commenced in 1851, in which Exhibition the first rude sketch was shown. This shield is in silver and iron, damascened with gold; it is entirely *repoussé*, or embossed; the subjects are dedicated to Shakespeare, Milton, and Newton. Shakespeare is represented seated in a bark, floating on the river of Immortality, attended by Apollo, the god of Poetry, and Minerva, the godess of Wisdom, who points to the vices of humanity, represented by figures tormented by monsters: Genii of Poetry support tablets, on which are inscribed the titles of his finest writings; an eagle ready to soar indicates the lofty flight of his genius; on the side of the vessel are entablatures of the "Seven Ages of Man." Milton is represented dictating to his daughter "Paradise Lost," inspired by Religion and Poetry; pourtrayed by two figures, one holding a torch and the other a lyre; crouching behind a shield is Satan. Newton is represented with a globe, contemplating the wonders of the heavens. Behind him are figures of Time and Truth and Wisdom, who rebuke Ignorance and Superstition, typified by two crouching figures. On the right is a figure of Earth instructing her children, Europe, Asia, Africa, and America. In low relief also, a figure represents the Sun, around which the Planets pursue their course. On the border is represented the fall of the apple, which led Newton to the discovery of the system of gravitation, and the incident relating to the prism; in the midst is Genius in a chariot, tracking space, indicative of his comprehensive mind—

> "Nature and nature's laws lay hid in night,
> God said, 'Let Newton be,' and all was light."

The other work also by Antoine Vechte is the Titan Vase, of Etruscan form, embossed from thin sheets of silver, in the highest and lowest possible relief. The subject, which is treated in the style of Michael Angelo, is the destruction of the Titans by Jupiter, who made war upon them for having imprisoned his father Saturn. The giant sons of Cœlus and Terra, seeking to revenge the death of the Titans, are seen attacking the gods and endeavouring to reach Heaven. On the summit of the cover is Jupiter, who, with stern and angry looks, grasps thunderbolts, which he hurls on the presumptuous Titans below. Bordering the cover, is the Zodiacal circle, in low relief. On the body of the vase, on each side, are groups of giants—some climbing upwards, some crushed by the rocks hurled by the mighty Jove. Supported by the handles of the vase, two bold, presumptuous giants stand out in full relief, vainly menacing the Father of gods and men. On the foot are fallen distorted figures, representing Vice and Presumption writhing in the agonies of death. On the neck of the vase, in low relief, are two figures, representing Time and Fate; the former with his scythe, the latter grasping serpents. This work was exhibited in 1851. The less important subjects on this beautiful vase will be well understood by those who examine it. A missal cover (unfinished), in platinum repoussé, by Antoine Vechte, executed for His Royal Highness the Duke d'Aumale, is a beautiful work. The subject of this work of art is the Assumption of the Virgin, who is represented surrounded by angels, about to place upon her head a celestial crown. At the angles are the four Evangelists, surrounded by delicate tracery in ornament, whilst stronger and more marked work surrounds the centre shield, bearing the arms of the Duc de Berry, the ancestor of His Royal Highness, who first commenced the ornamentation of the missal, about A.D. 1390, for which this cover is intended. The missal has been embellished and illuminated by celebrated French, Flemish, and Italian artists, of the middle of the fifteenth century, when Jane of Savoy, granddaughter of the Duke, caused a French artist to complete the work.

Numerous race cups are exhibited, and in these we see almost every style of art in metal work illustrated.

The trophy by Messrs. Elkington and Co. is a remarkable combination of art and manufacturing skill. Upon the summit stands the bronze group of Boadicea in the act of threatening to avenge the insult offered to her daughters by the Romans. This group was modelled by the late Mr. John Thomas; the original marble was executed for Sir M. Peto. The bronze, as referred to above, was exhibited in Paris, 1855, but not before in England.

At one side the trophy there are placed two statues, which have been produced by means of electro deposit, and form part of a series which have been presented to the Wellington College; one statue is of General Murray, the other that of Prince Blucher, both by Mr. William Theed; but he admits having adopted the latter from a statue already erected at Berlin. This statue of Blucher was presented to the college by the late Prince Consort. There is another bronze-deposited statue placed at the lower part of the trophy, Malcolm Canmore (or, Cæn Mohr), son of Duncan the First; it was modelled by Mr. Theed, by command of his late Royal Highness, for Balmoral, and now exhibited by permission granted previous to the decease of his Royal Highness.

Upon the base there is exhibited bronze statues, viz.—"Lesbia," by Cumberworth; "A Daughter of Eve," by J. Bell; and "The Young Naturalist," by Henry Weekes, A.R.A.

Above, in centre of the Wellington College statues, there is a suit of armour, copied from one in the Tower of London, and in deposited oxidised metal.

The other side of the trophy has statues of the barons of Magna Charta, viz. :—Langton, Archbishop of Canterbury, by the late John Thomas; the Earl of Norfolk, by T. Thornycroft; and Almeric, master of the Knights Templars, by P. Macdowell, R.A. They are the original models from which others were cast in bronze by Elkington and Co., all of which (eighteen forming the complete series) were executed, with the exception of Geoffrey of Gloucester, by J. S. Wentworth, since 1851.

There are several pieces, both groups and statuettes, in small bronzes, placed on one side of the trophy; and the principal feature of the other side is a table and mirror, formed from a model of the Alhambra, which was modelled upon the spot, and presented by William Penrose Mark, Esq., British Consul at Malaga, to Messrs. Elkington and Co.

Upon the end glass cases there are busts of most distinguished personages.

In addition to the numerous beautiful objects exhibited in this and Messrs. Elkington's case, on the eastern side of the Central Avenue, the silver Repoussé Table must be named; Morel Ladeuil is the artist to whom we are indebted for this fine work. It is intended to pourtray the poetical influences of Sleep, by the picturing in dreams of the ideal pursuit after Happiness in our waking existence.

To carry out the idea with simplicity, the artist has limited himself to three principal figures, symbolizing Agriculture, Music, and War; who, in the persons of a Husbandman, Minstrel, and Soldier, are sleeping on the tripod base, surrounded with the Instruments of their various callings.

The composition on the top is entirely of female figures. Victory has the prominent position in the Soldier's dream; she bears the Palm Leaf in her right hand, and the Book of History in her left; and is followed by Fame, who sounds her Trumpet with all the power at her command; Glory, with the everlasting Myrtle and military rewards, stretches forth her hand to crown the victor.

The Minstrel dreams of what he sings: Love, in the figure of an eastern beauty, surrounded by Cupids; Melody, with the Lyre, and robed with Music; Folly, with her Cap and Bells; and Fortune, who, kneeling on her emblematical Wheel, scatters Gold, unmindful of where it falls.

The third dream is that of the Agriculturist: and is one of Peace and Plenty. This group is completed by a figure bearing a Cornucopia, emblematic of Abundance.

The border is a fantastic creation, in the German manner, of Monsters and Reptiles, being intended to represent how hideous fancies will sometimes mingle with the fairer visions of the night.

The whole composition is surmounted by a statuette of the goddess of Sleep, strewing the slumber-laden Poppy over the world.

This firm exhibits a work of great novelty, in the combination of enamel and silver, in a set remarkable for its elegance.

There may be a few persons to whom it will be useful to be informed the meaning of the term Repoussé. We derive it from the French, and it signifies ornamented metal work, formed in relief by striking up the metal from behind, with a punch or hammer, until the required forms are roughly produced in relief upon the surface; the work being finished by the process of chasing.

There are several examples of Niello, which term is derived from the Italian *Nigellum*. This is the art to which we owe the origin of engraving; it consists in drawing a design with a style upon gold and silver, and then cutting it with a burin; a black composition, made by heating together copper, silver, lead, and sulphur, which when cold is pounded: it is then laid upon the engraved plate, a little borax sprinkled upon it, and placed over a charcoal fire, when the composition dissolves and flows into the lines of the design. When cold, the metal is scraped and burnished, and the niello presents the effect of a drawing in black, upon gold or silver. The art was known to the ancients and practised during the Middle Ages: specimens, though rare, are to be met with in museums. In the fifteenth century these designs were frequently engraved with great delicacy, and the shadows *hatched* with lines, precisely like a copper-plate engraving. The origin of taking paper impressions from metal plates is ascribed to the practice of Maso Finiguerra, a Florentine goldsmith, who in the middle of the fifteenth century was in the habit of taking impressions of his incised work on cups and plaques, in a viscid water-ink, on paper, for the purpose of testing the state of his work. Such impressions of the early fathers of copper-plate printing still exist, and are known as *niellos* also.

The exhibition of works of art in the precious metals by Messrs. Garrard and Co. is in the highest taste. One or two of their works only can be especially noticed.

A Fountain Temple, with portraits of horses, is a really beautiful work. From the scarcity of water in the desert, the spots where it flows have been hallowed for ages. The ancients in their veneration either erected monuments in their vicinity or sculptured the rock whence the water flowed. Hence has arisen the idea of the base of this work. The structure, which represents the idea of a covered fountain erected on the ruins of antiquity, is designed and composed in the style and spirit of the Alhambra. In the composition round the Temple, which illustrates Arabs leading horses to water, are portraits of three beautiful animals, the property of her Majesty. The grouping of both men and horses is so contrived as to be viewed with equal advantage on all sides, the action of each being extremely varied. On one side a negro boy is quietly gazing at the animal he has in charge; on another side a horse rearing, startled by the sudden escape of his companion, while the Arab is endeavouring to regain his hold. A Persian hound, aroused by the confusion, is in the act of barking. On the lower portion of the base, among the ruins, are introduced the flamingo and vulture; also the dome palm, banana, and other plants, natives of Arabia.

No less striking is a Vase in Cinque-Cento style, with subjects taken from Scott's "Lay of the Last Minstrel." The bassi relievi on the body represent the loss of the young Heir of Buccleuch, as described in Canto III., and the restoration, Canto V. Beneath are represented, by masks, the spirits of the Flood and Fell; and from the handles, which form part of the woodland scenery, arise the spirits of the air—

"Merry elves their morrice pacing
To aëriel minstrelsy."—Canto I."

The cover is surmounted by a figure of the minstrel, and upon the foot is armour of the period.

The testimonials, the cups, the candelabra, and the useful plate, are all alike of the highest character. There are, however, two groups which are very forcibly rendered. The first is the charge of Charles, King of Bohemia, at the Battle of Crecy. "Charles of Luxemburg, the gallant King of Bohemia, having heard the order of battle, inquired where his son, the Lord Charles, was; his attendants answered that they believed he was fighting. The king said to them, 'Gentlemen, you are all my people, my friends, and brethren-at-arms this day: therefore, as I am blind, I request of you to lead me so far into the engagement that I may strike one stroke with my sword.' The knights replied that they would directly lead him forward, and, in order that they might not lose him in the crowd, they fastened all the reins of their horses together."

The other is founded on the following incident:—During the games at Stiriing, which King James attended, the exiled Douglas appeared, and joined the sports an unbidden guest. After his having been declared victor in every trial of strength and skill, a noble stag was let loose, intended to be pulled down by the royal hounds; but Lufra darted from her master's side, and, like him, soon gave evidence of her superiority. The indignant huntsman, in revenge, struck the dog, when Douglas, with one buffet, laid him stunned at his feet: then—

'Clamoured loud the royal train,
And brandished swords and staves amain;
But stern the Baron's warning,—Back!
Back on your lives, ye menial pack!
'Beware the Douglas.'"
SCOTT's "Lady of the Lake."—Canto v., stanza xxvi.

C. F. Hancock is the exhibitor of a chastely elegant group in silver, which is intended to illustrate and embody some of the greatest and best-known creatures of the poets. It consists of a central vase dedicated to Shakespeare. Two loving-cups and two tazzas, respectively dedicated to Milton, Byron, Moore, and Burns, thus embracing illustrations of the dramatic, classical, romantic, lyrical, and popular poetry of the British Isles. The subject-story of each piece will be sufficiently understood by all those to whom these poets are familiar. These beautiful works are designed and modelled by Signor Monti. To attempt to describe the gold bracelets, chains, and articles which may be grouped with them, is impossible. It is equally so to give any description of the great variety of tea and coffee services, dinner services, candelabra, centre pieces, cups, vases, and the like, exhibited by those whose names appear at the head of this section.

ELECTRO-PLATED GOODS AND GILT METAL.

Exhibitors.—**H. Adkins and Son (6596), Atkin Brothers (6599), W. E. Barry (6603), J. M. Benson (6605), Birmingham Committee (6606), G. R. Collis and Co. (6611), Derry and Jones (6612), J. Dixon and Sons (6614), Elkington and Co. (6619), W. W. Harrison (6630), W. Lister and Sons (6645), A. M. Loach (6646), Mappin Brothers (6650), Martin, Hall and Co. (6653), J. Muirhead and Son (6654) Portland Co. (6659), T. Prime and Son (6660), Reid and Sons (6662), Smith and Nicholson (6667). H. Tatnell (6670), T. Wilkinson and Co. (6679), Wills Brothers (6680), H. Wilkinson and Co. (6678).**

The process of electrotype deposit has almost superseded the old process of plating; but not entirely so. This being the case, some description of the old process is necessary.

An ingot of copper or of German silver being cast, and the surfaces carefully prepared, by filing, so as to remove all blemishes, and a piece of silver, having likewise one surface perfectly cleaned, are tied together by means of iron wire. A mixture of borax in water is then drawn round the edges with a quill. They are next placed in a common air furnace, to be heated to a proper temperature, and having a small aperture in the door through which the workmen can observe when that temperature is attained. During the union of the two bodies, the surface of the silver is seen to be drawn into intimate contact with the copper or German silver, and the moment this takes place is the signal for removing the bar from the furnace. The appearance of incipient admixture on the edges of the the silver shows how perfect the fusion has been, as this oozing of the metal is not in consequence of any extraneous application of solder, &c., but entirely the effect of the fusion of the surfaces of the two bodies.

The ingots being thus prepared, the next process is that of rolling them into sheets, which is done by large cylinder rollers moved by water or steam-power, and between which the plated metal has to be passed many times before it is reduced to the desired substance. The extent to which the ingots are rolled, depends upon circumstances, and the thickness of the ingot is determined by the description of articles that are to be made from it. For instance, large and small dish-covers are rolled different widths. Table dishes of various sizes require different widths and substance. A 12-inch and a 21-inch dish require each a different sheet; for that which would be of proper strength for a 21-inch dish would be too thick for a 12-inch.

The lamination which the silver undergoes during the operation of rolling proves the perfect unity of the two bodies. The union between two metals produced in this manner is so perfect that the finest wire, plated in the round ingot by fire, has been drawn out to five hundred times its original length without detaching the silver.

The plated metal being rolled into sheets, is now ready for being fashioned into the different articles, of which it is only to form the bodies and plain surfaces, nearly all the ornamental parts being formed separately of silver by means of dies.

Electro-plating is now tolerably familiar to every one. A solution of cyanide of potassium is usually employed. The method generally adopted is as follows:—Metallic silver is dissolved in four parts of nitric acid, diluted with one part of water; the diluted acid is heated in a vessel, and the silver is added by degrees. The operator must avoid breathing the fumes which ascend, as they are highly deleterious. The metal being dissolved, the solution is transferred to a large vessel, and diluted with water. To this is added a solution of cyanide of potassium, so long as a white precipitate is formed. This precipitate is cyanide of silver. When the precipitate of cyanide of silver has settled, the clear solution is carefully decanted, and the vessel filled up with water, which is again decanted as soon as the precipitate has settled. This process is to be repeated three or four times, so as effectually to wash out the soluble salts. When properly washed, a solution of cyanide of potassium is added to the precipitate until it is all dissolved.

The resulting solution constitutes the cyanide of potassium and silver, and forms the plating solution.

The solution for gilding is prepared in an analogous manner by dissolving gold in a solution of the cyanide, or of some salt which possesses the property of holding the metal in the condition of weak affinity.

The voltaic battery may be described as a furnace in which zinc is burnt instead of coal; and during this change—this oxidation of the metal by the acid employed—an equivalent of electric force is developed, and this being by an arrangement of wires conducted to the cell in which the article to be plated or gilded is placed, an exact equivalent of gold or silver is deposited.

The voltaic battery has been employed in most manufactories for effecting the electro-chemical decomposition; but

Mr. Prime, of Birmingham, and the Messrs. Elkington, have employed powerful magnets as permanent sources of electricity. It may be stated, that when the armature of a magnet is set in motion in front of the poles of a magnet, a current is generated. This is accumulated by large coils of copper wire, and the ends being brought into the decomposing cells, the same effect is produced as results from the battery current.

In this case the deposits in the decomposing cell exactly represent the mechanical power employed to produce the motion, such is the exactness of the laws of Nature, such the harmony of all her work. Of the style and character of the works in electro-plate, it is not neccessary to speak.

Britannia and Imperial metals, which are exhibited in this Class as the bodies upon which the electro-plating is effected, are both composed of tin, regulus of antimony, and small portions of copper and brass. Articles of a complicated form of this metal are cast in brass moulds: of this class are ornamental candlesticks, tea-pot handles, feet, &c. The bodies of tea-pots, &c., are produced by what is called spinning —a process by which fine thin discs of rolled metal are made to take the convex or globular form of the object desired; which is effected by the disc being placed against a suitable wooden block or chuck, which revolves in a lathe; and by means of the pressure of a steel tool or burnisher, the thin plate of metal is pressed against, and finally takes the form required. When in two or more parts, they are soldered together by tin solder, which is melted by the heat of a blowpipe, and this completes the adhesion of the two parts. Among the later improvements in electro-metalling has been the successful application of this mode of silvering to the softer and less valuable metals, which has given an impulse to the production of articles elegant in form, and cheaper in proportion as the value of the foundation on which the deposit is made decreases.

Spoons, forks, &c., are formed by being cut out of sheets of rolled German or nickel silver. The instrument used to effect this purpose is an ordinary press and tools: the ornamentation is produced by a die and stamp, as is also the hollow in the mouth of the spoon: the forms are then corrected by hand, cleansed, and the electro-deposit made thereon, as in other articles. They are afterwards brushed with a revolving brush, while wet (beer-grounds being used), and finally burnished by hand.

British gold is exhibited in this Class; for a full description of the discovery of this, see Vol. I. page 8.

Aluminium groups of great beauty are also shown; this metal and its uses are also described in Class I. Vol. I. page 5.

Some works in platinum have been already noticed. The most recent improvements in working this fine and durable metal will be found in Vol. I. page 21.

JEWELLERY AND GEMS.

Exhibitors—T. Aston and Son (6598), R. Attenborough (6600), J. Balleny (6601), Birmingham Committee (6606), J. Biden (6607), T. and J. Bragg (6608), C. Bryan (6609), Brydone and Sons (6610), J. Duncan (6618), Ellis Bros. (6620), E. and E. Emanuel (6621), H. Emanuel (6622), A. Forrer (6623), R. and S. Garrard and Co. (6625), J. Goggin (6626), C. Green (6627), R. A. Green (6628), C. F. Hancock (6629), Hazleton (6631), Hilliard and Thomason (6632), Howell, James and Co. (6633), Hunt and Roskell (6634), G. Jamieson (6635), J. Johnson (6637), B. Lee (6643), J. Lees (6644), W. Lister and Sons (6645), A. M. Loach (6646), A. D. Loewenstark and Sons (6647), London and Ryder (6648), W. Marshall and Co. (6652), J. Nelis (6655), Parker and Stone (6656), Rettie, Middleton and Sons (6663), J. Reading (6661), J. Russell (6665), C. T. Shaw (6666), W. Spencer (6668), J. Tennant (6671), B. W. Westwood (6674), J. A. Wheatley (6675), Widdowson and Veale (6676), R. Restell (6682).

DIAMONDS.

In 1851 the Koh-i-Noor was the centre of attraction. From the interest which was then attached to this gem—it having been a recent acquisition—I made an application to the East India Company for some special information respecting it. I was favoured, in reply, with an account which I published in my "Handbook to the Official Catalogue," and which, from its value as a correct history, I again publish.

The diamond denominated the Koh-i-Noor, or Mountain (koh) of Light (noor), has long enjoyed both Indian and European celebrity, and has accordingly been the subject of traditionary fable, as well as of historical record.

According to Hindu legend, it was found in the mines of the south of India in the days of the Great War, the subject of the heroic poem, the *Maha'bha'rata*, and was worn by one of the warriors who was slain on that occasion, Karna, king of Anga: this would place it about five thousand years ago, or 3001 B.C. A long interval next makes it the property of Vikramaditya, the rajah of Mjayin, 56 B.C., from whom it descended to his successors, the rajahs of Malwa, until the principality was subverted by Mohammedan conquerors, into whose hands it fell, with other spoils of infinite value.

Whatever may be thought of the legend which gives so high an antiquity to the Koh-i-noor, we might expect some more trustworthy information when we come down so low as the beginning of the 14th century; Malwa having been invaded and overrun by the armies of Ala-addin, the sultan of Delhi, in 1306, who, according to the autobiography of the sultan Baber, acquired the jewel. That it did become the property of the sultanas of Delhi is little doubtful; but when or how, is matter of some uncertainty, although the grounds of the difficulty have not hitherto been investigated.

In 1655 Mons. Jean Baptiste Tavernier, an enterprising and intelligent traveller, and an eminent jeweller, although Ecuyer, Baron d'Aubonne, visited India especially to purchase diamonds. His profession and his personal character seem to have recommended him to the favourable attention of the nobles of the court of Delhi, and, bigot as he was, of Aurangzeb himself, by whose commands Mons. Tavernier was permitted to inspect and handle and weigh the jewels of the imperial cabinet. Amongst them was one which far surpassed all the rest in size and value. Tavernier describes it as rose-cut, of the shape of an egg cut in two, of good water, and weighing 319½ *ratis*, which, he says, is equal to 280 of our carats.

There is but little doubt that the diamond examined by Tavernier, in the Delhi cabinet, was the Koh-i-Noor. Baber, the Mogul emperor, obtained a diamond, corresponding exactly with this, and it passed eventually into the possession of the the ruling family of Kabul. Nadir Shah, on his occupation of Delhi in 1739, compelled Mohammed Shah, the great-grandson of Aurangzeb, to give up to him everything of value that the imperial treasury possessed, and his biographer and secretary specifies a *peshkash*, or present, by Mohammed Shah, to his conqueror, of several magnificent diamonds. According to the family and popular tradition Mohammed Shah wore the Koh-i-Noor in front of his turban at his interview with his conqueror, who insisted on exchanging turbans in proof of his regard. However this might have been, we need have little doubt that the great diamond of Aurangzeb was in the possession of Mohammed Shah at the time of the Persian invasion; and if it was, it most certainly changed masters and became, as is universally asserted, the property of Nadir Shah, who is also said to have bestowed upon it the name of Koh-i-noor. After his death, the diamond which he had wrested from the unfortunate representative of the house of Timur, became the property of Ahmed Shah, the founder of the Abdali dynasty of Kabul, it having been given to him, or more probably taken by him, from Shahrikh, the young son of Nadir. The jewel descended to the successors of Ahmed Shah, and when Mr. Elphinstone was at Peshawur, was worn by Shah Shuja, on his arm. When Shah Shuja was driven from Kabul, he became the nominal guest and actual prisoner of Runjet Sing, who spared neither importunity nor menace, until, in 1813, he compelled the fugitive monarch to resign the precious gem, presenting him on the occasion, it is said, with a lakh and twenty-five thousand rupees, or about twelve thousand pounds sterling. According to Shah Shuja's own account, however, he assigned to him the revenues of three villages, not one rupee of which he ever realized. Runjet was highly elated by the acquisition of the diamond, and wore it as an armlet at all great festivals. When he was dying, an attempt was made by persons about him, to persuade him to make the diamond a present to Jagannuth, and it is said that he intimated assent by an inclination of his head. The treasurer, however, whose charge it was, refused to give it up without better warrant, and Runjet dying before a written order could be signed by him, the Koh-i-Noor was preserved for awhile for his successors. It was occasionally worn by Rhurreuk Sing and Shu Sing. After the murder of the latter, it remained in the Lahore treasury until the supercession of Dhulip Sing, and the annexation of the Punjaub by the British Government, when the civil authorities took possession of the Lahore treasury, under the stipulations previously made, that all the property of the state should be confiscated to the East India Company, in part payment of the debt due by the Lahore government, and of the expenses of the war; it was at the same time stipulated that the Koh-i-Noor should be presented to the Queen of England. Such is the strange history of certainly one of the most extraordinary diamonds in the world. After the Company became possessed of the gem, it was taken in charge by Lord Dalhousie, and sent by him to England in custody of two officers.

The want of brilliancy in the gem, as seen in 1851, led her Majesty to request Sir David Brewster, Mr. Tennant, and some other authorities to examine it. Upon the recommendation of these gentlemen it was confided to Messrs. Garrard for the purpose of being recut. Owing to the extreme irregularity of the stone, for, as shown by the model exhibited, a large piece had been split off at the cleavage plane, this improvement could only be effected by a great sacrifice of weight, which however is now fully balanced by the apparent increase in size and the great brilliancy acquired.

On account of the irregular shape already alluded to, great skill was required to insure success, and the Koh-i-Noor is consequently exhibited as a triumph of diamond cutting.

Mr. Tennant published a very interesting account of the process of cutting the Koh-i-Noor, which will be of interest to many of those who are so anxious to see this noble gem, the property of the British Crown. The letters in the following extract, refer to a drawing which accompanied the original pamphlet; they are retained, as conveniently indicating the particular flaws in the original diamond.

"In cutting diamonds from the rough, the process is so uncertain that the cutters think themselves fortunate in retaining one-half the original weight. The Koh-i-Noor, on its arrival in England, was merely surface cut, no attempt having been made to produce the regular form of a brilliant, by which alone lustre is obtained. By reference to the figures, which are the exact size of the Koh-i-Noor, it will be clearly understood that it was necessary to remove a large portion of the stone in order to obtain the desired effect, by which means the apparent surface was increased rather than diminished, and the flaws and yellow tinge were removed.

"The process of diamond-cutting is effected by an horizontal iron plate of about ten inches diameter, called a *schyf*, or *mill*, and which revolves from 2000 to 3000 times per minute. The diamond is fixed in a ball of pewter at the end of an arm resting upon the table, in which the plate revolves; the other end, at which the ball containing the diamond is fixed, is pressed upon the wheel by moveable weights at the discretion of the workmen. The weight applied varies from 2 to 30 lbs. according to the size of the facets intended to be cut. The recutting of the Koh-i-Noor was commenced on July 16th, 1852, his Grace the late Duke of Wellington being the first person to place it on the mill; the portion first worked upon was that at which the planes P and F meet, as it was necessary to reduce the stone at that part, and so to level the set of the stone before the table could be formed; the intention being to turn the stone rather on one side, and take the incision or flaw at E, and a fracture on the other side of the stone, not shown in the engraving, as the boundaries or sides of the girdle. The next important step was the attempt to remove an incision or flaw at C, described by Professor Tennant and the Rev. W. Mitchell as having been made for the purpose of holding the stone more firmly in its setting, but pronounced by the cutters (after having cut into and examined it) to be a natural flaw of a yellow tinge, a defect often met with in small stones. The next step was cutting a facet on the top of the stone immediately above the last-mentioned flaw. Here the difference in the hardness of the stone first manifested itself; for while cutting this facet, the lapidary, noticing that the work did not proceed so fast as hitherto, allowed the diamond to remain on the mill rather longer than usual, without taking it off to cool; the consequence was, that the diamond became so hot from the continual friction and greater weight applied, that it melted the pewter in which it was imbedded. Again, while cutting the same facet, the mill became so hot, from the extreme hardness of the stone, that particles of iron, mixed with diamond powder and oil, ignited. The probable cause of the diamond proving so hard at this part is, that the lapidary was obliged to cut directly upon the angle at which two cleavage planes meet, cutting across the grain of the stone. Another step that was thus considered to be important by the cutters, was removing a flaw at G. This flaw was not thought, by Professor Tennant and Mr. Mitchell, to be dangerous, because if it were allowed to run according to the cleavage, it would only take off a small piece, which it was necessary to remove, in order to acquire the present shape. The cutters, however, had an idea that it might not take the desired direction, and therefore began to cut into it from both sides, and afterwards directly upon it, and thus they succeeded in getting rid of it. While cutting, the stone appeared to become harder and harder the further it was cut into, especially just above the flaw at A, which part became so hard, that, after working the mill at the medium rate of 2400 times per minute, for six hours, little impression had been made; the speed was, therefore increased to more than 3000, at which rate the work gradually proceeded. When the back (or former top) of the stone was cut, it proved to be much softer, so that a facet was made in three hours, which would have occupied more than a day, if the hardness had been equal to that on the other side; nevertheless, the stone afterwards became gradually harder, especially underneath the flaw at A, which part was nearly as hard as that directly above it. The flaw at N did not interfere at all with the cutting. An attempt was made to cut out the flaw at A, but it was found not desirable on account of its length. The diamond was finished on September 7th, having taken thirty-eight days to cut, working twelve hours per day without cessation."

The art of DIAMOND-CUTTING being principally carried on in Amsterdam, is but little understood in England, and in order that the public may have an opportunity of being made acquainted with the art, Messrs. Hunt and Roskell have erected a mill in the Western Annex, where the process may be seen and clearly explained by Mr. Auerhaan, who succeeded the person Messrs. Hunt and Roskell originally obtained from Holland to cut the Nassuck diamond. The chief difficulty in diamond-cutting exists in the fact that the diamond is the hardest substance known to exist, and it follows that it can only be cut by itself, and that in polishing it a great rapidity of motion is necessary. The first step taken with diamonds of ordinary size is to set them in cement on the ends of two pieces of wood, which are then held in the hands and rubbed together, and the one diamond grinds the other away to something of the form required. The dust, which is of considerable commercial value, is carefully preserved for the purpose of polishing.

After cutting, in order to proceed with polishing the stone, the diamond is embedded in soft metal, and, by means of clamps, brought to bear upon the skieve at the proper angle.

The skieve is a horizontal plate composed of soft iron, and this plate is charged with diamond powder and oil, and has a revolution imparted to it of from 2000 to 2500 times a minute; it is about twelve inches in diameter, and the periphery, therefore, travels at the rate of about 100 miles per hour, and runs until the required facet is formed and polished; for the skieve first cuts, and then, as the powder runs fine, polishes.

On the double-cut diamond there are sixty-two of these facets: namely, on the upper part thirty-three, and beneath the girdle twenty-nine. Large diamonds are not exposed to the risk of cutting, but are polished from the rough on the skieve. The largest manufactory is in Amsterdam, and possessed by Mr. Coster, who, in the Netherlands' Court, Class 33, No. 362, exhibits a diamond, called the "Star of the South," weighing 500 grains, and also rough diamonds, from the various mines, and others in the cut and polished states. This gentleman was employed to cut the Koh-i-Noor.

Messrs. Garrard are also exhibitors of several very elegant sets of diamonds of great value; the most remarkable being a large brilliant drop, of the finest quality and remarkable lustre, weighing 76½ carats. This matchless gem, acknowledged to be the finest for sale in Europe, is the property of E. Z. Dresden, Esq. Price 50,000*l*. A necklace of very fine single brilliants, with a large and fine solid diamond drop, matchless in point of size and quality.

Mr. Harry Emanuel exhibits amongst his fine collection, five brilliants of very large size, mounted as stars. The largest weighs 100 grains, the smallest 45 grains.

Messrs. Hunt and Roskell are large exhibitors of precious stones.

Among the jewels are the Nassuck and Arcot diamonds, the property of the Most Noble the Marquis of Westminster, by whose permission they are exhibited. The Nassuck was cut by Messrs. Mortimer and Hunt, in 1841 (before the retirement of Mr. Mortimer), at their own manufactory; its weight was 357½ grains, and is now 340 grains. The upper part of the stone is perfectly cut. The Arcot diamonds consist of a round stone, weighing 125 grains; and two drops, weighing 223½ grains. These diamonds are of the finest quality.

They have also a fine brilliant, weighing 93½, and another 95½ grains, set as stars.

Mr. Hancock exhibits a splendid diamond, of the value of

4000*l*., and a diamond suite, the price of which is 80,000*l*. He has also a fine green diamond, and another of a yellow colour. Lambert and Co. are exhibitors of a very fine tiara of diamonds.

To many persons the value of a diamond is a matter beyond their comprehension; they cannot understand the rapid increase in price with the apparently small increase in size. The rule which prevails is as follows:—

Diamonds possessed of no extraordinary magnitude, but of a good form and a pure water, may be valued by a certain standard rule. In a brilliant, or rose-diamond of regular proportions, so much is cut away that the weight of the polished gem does not exceed one-half the weight of the diamond in the rough state; whence the value of a cut diamond is esteemed equal to that of a similar rough diamond of double weight exclusive of the cost of workmanship. The weight and value of diamonds is reckoned by carats of 4 grains each; and the comparative value of two diamonds of equal quality, but different weights, is as the squares of these weights respectively. The average price of rough diamonds that are worth working, is about 2*l*. for one of a single carat; but as a polished diamond of one carat must have taken one of two carats, its price in the rough state is double the square of 2*l*., or 8*l*. Therefore to estimate the value of a wrought diamond, ascertain its weight in carats, double that weight, and multiply the square of this product by 2*l*. Hence a wrought diamond of

1	carat is worth	£ 8	7	carats is worth	£392
2	,,	32	8	,,	512
3	,,	72	9	,,	612
4	,,	128	10	,,	800
5	,,	200	20	,,	3200
6	,,	288			

beyond which weight the price can no longer rise in this geometrical progression, from the small number of purchasers of such expensive toys. A very trifling spot or flaw of any kind lowers exceedingly the commercial value of a diamond.

SAPPHIRE AND RUBY.

These stones are two varieties of one mineral, the sapphire, properly so called, and the oriental ruby, whose chief difference consists in their colour, although the hardness of the latter is also distinctly lower; both these stones are composed of alumina, with a variable intermixture of silica and oxide of iron. Sapphire has obtained several names, dependent on its colour and lustre: the transparent or translucent, *white sapphire;* the blue, *oriental sapphire;* with pearly reflections, the *chatoyant* or *opalescent sapphire;* when transparent, and with a pale reddish or bluish reflection, *girasol sapphire.*

Blue sapphires are principally brought from Ceylon, either in six-sided prisms, variously terminated, or in rolled masses from the beds of torrents; perfect specimens have been found upwards of three inches in diameter. The finest red sapphires are found in the Capelau mountains, twelve days' journey from Sirian, a city of Pegu; it also occurs near Billin and Meronitz, in Bohemia; in the sand of the brook Exhaillie, in France; at Breudola; on Mount St. Gothard; and in Portugal.

Other red minerals used in jewellery are the Spinel—an aluminate of magnesia, containing a small quantity of chromic acid; the lime garnet and iron garnet. Many of the varieties of the first species are known as rubies, with various qualifying adjectives, as spinel ruby, balas ruby, &c. The term almanoline appears to be applied to both spinel and garnet.

Hunt and Roskell are exhibitors of a very fine sapphire, weighing 680 grains, and a fine ruby spinel, 323 grains; these stones are set with *entourages* of brilliants. The ruby spinel was recently cut by Messrs. Hunt and Roskell, from a stone possessed by various kings of Delhi, similar in shape to those forming the Queen's necklace, exhibited in Messrs. Garrard's case. They exhibit also a splendid sapphire and diamond suite, together with some fine diamonds, pearls, opals, &c., the property of the Earl of Dudley; and a head ornament, containing a remarkably fine and large ruby, a "*pierre d'échantillon,*" set with other rubies and diamonds, the property of R. S. Holford, Esq.

The Lahore rubies are exhibited by Messrs. Garrard and Co.; they are the property of her Majesty the Queen, composed of three very large uncut rubies from the treasury of Lahore, and three very fine brilliant drops set in Indian style; two of these drops were originally in the Koh-i-noor armlet. The centre ruby bears a Persian inscription, of which the following is a literal translation:—"A ruby which out of the twenty-five thousand genuine jewels of the Sultans of the world, the Sultans Lords of the century, is come to this place from the treasury of Hindostan, in the year 1153. Ahmed Shah, the pearl of pearls, 1168."

The side rubies bear Persian inscriptions also, and are thus translated:—"Alem Ghir Shah, 1070. Mohammed Ferrah Thyri, the warrior sovereign, 1125."

They also exhibit a parure of rubies and diamonds, consisting of a brooch, bracelet, necklace, and ear-rings. The stones are all of the finest quality, the ruby in the bracelet being especially remarkable for its size, lustre, and purity.

Mr. Hancock exhibits the celebrated Caversham sapphire, valued at 20,000*l*., and they have also another fine jewel, the worth of which is 7,500*l*. The ruby suite exhibited in this case is in the highest degree beautiful; its value is 12,000*l*.

EMERALDS.

These gems were called beryls by the Greeks—aqua-marine, from the Latin (*sea-water*), in relation to its colour—but they are more commonly known as *emeralds*. They are composed of glucina, silica, and alumina. The most splendid crystals of emerald occur in a vein of magnesian limestone, which traverses a horneblende rock at Muso, near Santa Fe de Bogota, in new Granada. Less distinct varieties occur at Mount Zalora, in Upper Egypt, the only locality of emerald with which the ancients are believed to have been acquainted; at Cangarjum, in the district of Coimbetoor, in Hindustan; and imbedded in mica slate in the Henbach valley, Pinzgau district, Salzburg.

Messrs. R. and S. Garrard exhibit a pendant, with emerald cross centre and brilliant border, with small emerald points and fine solid emerald drop; and a pair of ear-rings to correspond, also with solid emerald drop, in addition to which is a large drop brooch of emerald and diamonds.

Harry Emanuel has a brooch, consisting of an enormous emerald, singularly free from flaws and of magnificent colour, mounted on a riband of large brilliants, and having as pendant a pearl of matchless size and beauty, two inches in length. The emerald weighs 156 carats.

Hunt and Roskell have some remarkably fine emeralds and aqua marines. In Mr. Hancock's case will be found, in the Devonshire collection, a perfect hexagonal crystal, two inches long; it measures across its three diameters, 2¼ in., 2⅓ in., and 1⅞ in., and weighs 8 oz. 18 dwts.; owing to flaws it is but partially fit for jewellery. In the same case will be found an emerald in the matrix, the property of Lord Auckland. Mr. Phillips exhibits some exquisitely fine emeralds, and in the collection of Howell, James and Co., are some very interesting examples of this gem. It has always been stated that the colour of the emerald was due to the presence of oxide of chromium. M. Lewy appears, however, to have proved it to be due to organic matter.

M. Lewy visited a mine called Muzo, in New Granada, Mexico, and obtained some fine specimens of emeralds, and of the rocks in which those precious stones are found. He observed that the largest and finest emeralds could be reduced to powder by a slight squeezing or rubbing between the fingers when first obtained, but that they acquired hardness after a certain time and repose. It has been commonly stated that the colouring matter of the emerald is chrome, but M. Lewy attributes it to an organic colouring matter, analogous to *chlorophyle*, the green of leaves. He states that the emerald exposed to heat loses all colour; whereas minerals coloured by chrome, do not lose their green colour by ignition. His analysis of the Mexican mineral is as follows:—

Silica - - -	67·9	**Magnesia** - -	0·9
Alumina - -	17·9	**Soda** - - -	0·7
Glucina - -	12·4		

The green colour of the emerald is darkest in those specimens which furnish to analysis most organic matter: it is completely destroyed by heat, becoming white and opaque.

OPALS.

There are some beautiful specimens of the precious opal, exhibited by Mr. Hancock, by Mr. Phillips, by Messrs. Garrard, Hunt and Roskell, Howell and James, and others.

The common opal and semi-opal are found in large quantities in Hungary; and the wood opal is found at Kremnitz and Telkobanya, and in some districts of Transylvania.

The phenomenon of the play of colours has not hitherto been satisfactorily explained. According to Haüy, it is in consequence of fissures in the interior filled with thin films of air. This is not, however, proved by any microscopic observation; the probability is, that the iridescence is due to the molecular arrangement of the particles of which it is constistuted and to their physical condition.

There are many varieties of the opal. The *precious opal* exhibits a play of rich colours. The *girasol*, or *fire opal*, presents bright hyacinth red and yellow reflections. *Hydrophane*, *Cacholong*, *Hyalite*, *Menilite*, and *Opal Jasper*, are varieties. There are some others, but they are of little value. The precious opal, when large and exhibiting its peculiar play of colours, is a gem of high value. The largest mass of which we have any knowledge is in the Imperial Cabinet of Vienna; it is nearly as large as a man's fist, and weighs 17 ounces. This stone was used as a gem by the Greeks and Romans, and regarded as of high value by them. Its beautiful play of colours is described in the Orphic poems, where it is said that this gem has "the delicate complexion of a lovely youth."

AMETHYST.

These are varieties of quartz.

The amethyst chiefly differs from common quartz in its colour, which is purplish violet, supposed to be derived from a minute proportion of iron and manganese which it contains: it becomes white and opalescent by long exposure to heat.

Heintz analyzed a Brazilian specimen, and obtained, besides silica, 0·0187 oxide of iron; 0·6236 lime; 0·0123 magnesia, and 0·0418 soda; and he considers the colour owing to a compound of iron and soda.

The best amethysts are brought from Cambay, in India; from Siberia, Ceylon, and Persia, where they are found both lining the cavities of geodes and in rolled masses; of inferior transparency and hue, they occur in Sweden, Brazil, the Hartz, Bohemia, Transylvania; in agate balls at Oberstein, in Germany; in large crystalline groups near Cork; and in several parts of the United States.

Mr. Attenborough exhibits a remarkable specimen of the *oriental amethyst*. This is a sapphire. The red sapphire is sometimes called the *oriental ruby:* the yellow is the oriental *topaz*, of which very fine examples are shown; the green, the oriental *emerald;* and the asteriated crystals, *asteria.*

QUARTZ.

False Topaz is a light yellow pellucid variety of quartz.

Cairngorms are coloured quartz crystals. Of this there are very fine crystals shown by Lord Seafield in Class I. They are exhibited, mounted, by Rettie, Middleton, and Sons. These stones derive their name from their being found in that district of the Grampians which is known as Cairngorm.

Chrysoprase, exhibited by London and Ryder, is an apple-green variety of calcedony. *Agate*, of which there are several very fine specimens, is a variegated calcedony.

Onyx, of which there is a remarkably fine specimen, used as the cover for a tripod, by Phillips, is a stone resembling agate; but the colours, usually a light brown, and an opate white, are arranged with great uniformity. When the layers consist of *Sard* and white calcedony, it is called *Sardonyx*.

ROCK CRYSTAL includes the pure varieties of quartz. In Messrs. Howell and James's collection will be found a remarkable example of a crystal vase, of large size, beautifully mounted after a design by Benvenuto Cellini. The enamelled crystals, exhibited by this firm, and the intaglio crystals of

Lambert and Co., are novel and interesting. The rock crystal is engraved in intaglio, and carefully painted. This is mounted, and the engraving is seen through the crystal, which being cut of a spherical shape greatly increases the effect.

Chrysolite, Peridot, Olivine.—Under these names we have a siliceous gem, called by the ancients, from its colour, *goldstone.* It is exhibited under both names by Howell and James.

Cat's Eye.—This is a translucent quartz, presenting a peculiar opalescence, or glaring internal reflections, when cut *en cabochon*, which effect is owing to filaments of asbestros. There is a fine specimen in Hunt and Roskell's case.

Amongst the miscellaneous series connected with gems, we must name a Cup, carved from a solid piece of topaz, mounted in pure gold *repoussé*, and enamelled in parts, exhibited by Harry Emanuel. The subject represented is Perseus and Andromeda, and it is treated in the style of Cellini, with whose works it has been adjudged by many connoisseurs worthy of comparison. The grace of the composition, the truthfulness of the modelling, and the harmonious blending of colours, added to the magnitude of the work, render it one of the most important specimens of goldsmith's work ever made in this country. Andromeda is chained to the rocks which support the cup, whilst the dragon has climbed up to attack Perseus, who, mounted on Pegasus, and armed with the sword of Vulcan and the shield of Minerva, surmounts the cover. The model, design, and execution, are alike the work of Mr. Chesneau.

PEARLS.

Pearls are produced by a testaceous fish of the oyster kind, which lives in the waters of the East and West Indies. The worth of a pearl is in proportion to its magnitude, round form, clear nature, and fine polish.

Among a large number of curious and interesting specimens are several examples of the oyster containing pearls, the shell of an oyster with the pearl attached. Any substance being placed within the shell of the pearl oyster, it occasions, probably by irritation, a secretion of pearly matter. They avail themselves of this in China, and produce curious figures by placing small models within the shell of the living fish.

Messrs. Garrard have a necklace of four rows of pearls, of the finest orient, with a sapphire and diamond snap; and also another necklace of three rows of very fine pearls, and a pendant of brilliants, with a matchless black pearl centre and drop.

Messrs. Hunt and Roskell exhibit a row of thirty-two extraordinarily fine pearls, weighing 1254 grains, each pearl averaging upwards of 39 grains; value 8000*l*. It is believed to be the largest pearl necklace of so fine a quality for sale.

Mr. Harry Emanuel exhibits a bracelet, composed of alternate links of brilliants, turquoises, and pearls, set in gold, and a pair of pearl pendeloques, of large size and perfect colour and lustre, mounted as earrings, with brilliant tips.

Messrs. Garrard introduce remarkably fine pearls into much of their jewellery.

Messrs. London and Ryder also exhibit some very fine pearls.

There is a *case of pearls, found in the deepest part of the river Strules*, at the town of Omagh, Ireland. These pearls are procured from a species of fresh-water mussel, the *Unio margaritiferus*, a shell not uncommon in Ireland, Scotland, and Wales, and in the mountainous districts of England. They are often of great beauty and considerable value, but are rare, since not above one mussel in a hundred contains a pearl, and not one pearl in a hundred is of good quality. One of these pearls has been found of the diameter of half an inch. There have been instances of individual Irish pearls fetching as much as forty, fifty, and more pounds. The pearl mussel lives usually in rapidly-flowing streams, and is found in Norway, Sweden, and other mountainous parts of Europe, as well as in Britain.

CORALS.

The examples of coral exhibited by Mr. Phillips are of singular beauty.

The finest coral is found in the Mediterranean Sea. It is fished for on the coast of Barbary, in the Bay of Naples; and fine varieties, as regards colour, are found round Sardinia. A large trade in coral is carried on at Marseilles; but the finest kind of work is executed in the Neapolitan States. The coral is sometimes dredged for; but by this process it is often much broken, since, although the coral is attached to the rocks as a tree to the soil, its branches shoot downwards. To the divers this is an advantage, as it enables them readily to detach the coral from the rocks. For this kind of fishing, eight men, who are excellent divers, equip a felucca or small boat, commonly called a "coralline." They carry with them a large wooden cross, with strong equal and stout arms, each bearing a strong tagnet. They attach a good rope to the middle of the cross, and let it down horizontally into the sea, having loaded the centre with a weight sufficient to sink it. The diver follows the cross, pushes one arm of it after another into the hollows of the rock, so as to entangle the coral in the nets; then his comrades in the boat pull up the cross and its accompaniments.

Coral varies in colour, the commoner kinds being red; the delicate flesh-colour variety, which is very rare, fetching very high prices. We have seen an invoice for this choice coral, in which the manufacturer was charged 75 piastres, or 15*l.* 11*s.* 7*d.* sterling, for the Neapolitan ounce; as the Neapolitan ounce is one third less than the English ounce, we have 20*l.* 15*s.* 5*d.* as the price for that quantity, the value of gold being, at the present time, less than 4*l.* per ounce. There are also some corals of a yellow colour, and some quite white.

All kinds of coral being of considerable value, the skill of the workman is shown in the manner which he appropriates every portion to some useful end. The larger pieces are cut *en cameo*, and mounted for brooches, pens, &c. The other parts are cut into leaves or beads, so as to be used in combination to form bunches of grapes, or other graceful ornaments for brooches. Large beads are strung for bracelets, while the smaller ones are sent in very large quantities to India and the Colonies; the fragments too small for any other purpose are pierced and strung into necklaces, under the name of seed coral. Thus every portion, from the base to the terminal point of a branch, is appropriated by the skilled workman. In the remarkable collection of corals by Mr. Phillips, there are many examples of large corals, and of extraordinary displays of skill in workmanship. One piece of coral has been carved into a chain sufficiently large for a bracelet; and the ingenuity which has been displayed, in many other examples, in adapting the design to the peculiarities of the material, is exceedingly remarkable.

We should not do justice did we not state, that the revival of art-workmanship in coral, both in this country and in Italy, is entirely due to the enterprise of Mr. Phillips, whose collection is unique, and well deserving the inspection of the curious. He has some of the finest examples of gem carving in coral, and of ingenious combination, which were, perhaps, ever produced. And, independent of the art value, regarded merely as a subject of natural history, there is rarely to be seen such a collection of the commercial coral.

SUNDRIES.

Exhibitors.—G. W. Adams (6595), J. Dixon (6613), W. Francis (6624), H. de Koningh (6639), J. Law (6642), Mappin and Co. (6651), H. Robinson (6664), J. H. B. Thwaites (6683), T. Bell and Co. (6604), P. G. Dodd and Son (6615), H. MacCarthy (6681), and exhibitors already named.

There is an IVORY STATUETTE, two feet high, remarkable for the wonderful size of the block out of which it is carved, exhibited by Harry Emanuel. It represents a slave-girl in the act of liberating a bird; and the lines, a translation from the Greek, from which the artist, Mr. Chesneau, has taken his inspiration, will best convey the meaning of this production:—

"In gilded cage, like me you pine,
And long for home and playmates dear.
I cut the chain that makes thee mine:
Go, thou art free; I must stay here!"

The figure is ornamented with jewels, whose colours contrast admirably with the delicate hue of the ivory.

There are some fine examples of jewellery, in which the cairngorm forms the principal ornamentation.

The *Irish Bog-oak* is sufficiently well known, as are the Irish diamonds—quartz crystals—with which the articles manufactured from it are ornamented.

The *Sidmouth Stones* are somewhat of a novelty in ornamental manufacture.

The examples of gilt-work are remarkably fine, and the Wedgwood tables, mounted by Mr. W. E. Barry, cannot but be admired. Articles of this class, and indeed the miscellaneous class; for articles for personal decoration will be found to be very numerous.

As there are many examples of artificial gems, a few words on these appears necessary. The finest examples of these imitations will be found however in the French Court.

ARTIFICIAL GEMS.—*Strass*, so called after its inventor, is a glass possessing, in the highest degree, purity and transparency, combined with the greatest possible lustre. It is a mixture of quartz, boracic acid, and caustic potash purified by alcohol. In some specimens of Strass, red lead, and in others, white lead is employed. With perfectly pure and colourless Strass, the colouring agent is combined, the following being a few instances:—

Topaz - - Antimony and gold.
Ruby - - Purple of Cassius.
Emerald - Oxide of copper or chromium.
Sapphire - Oxide of cobalt.
Amethyst - Cobalt and gold.
Beryl - - Antimony and oxide of cobalt.
Garnet - - Gold, antimony, and manganese.
Opal - - Bone ashes, oxide of uranium, and forge scales, or, in some cases, oxide of nickel.

ARTIFICIAL PEARLS.—At an early period the practice of making hollow glass beads, and filling them with a pearly varnish, was adopted. Beads were thus made by some artists at Murano, but the government of Venice considered the invention too fraudulent, and prohibited its practice.

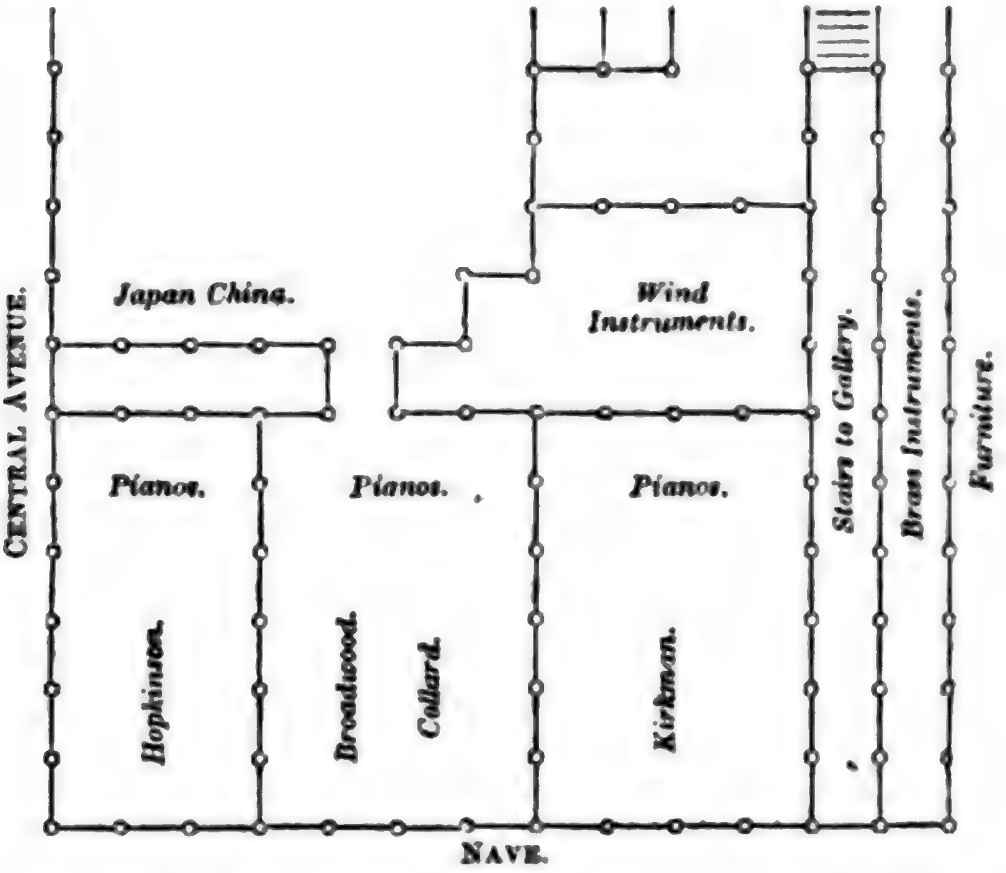
A French bead maker, Jaquin, revived and improved the art. He observed that the small fish called in France *ablette* —the bleak, *cyprinus alburnus*—filled the water in which they were washed with fine silver-coloured particles. The water, on standing, deposited a sediment which had the lustre of the most beautiful pearls; this led him to attempt the manufacture of pearls from it. He scraped off the scales of the fish, and called the pearly powder which was diffused through the water, *essence d'orient*, or essence of pearl. He first covered beads made of gypsum with this; but as the ladies who wore them found the pearly powder left the beads, and adhered to the skin, the use of these ornaments fell off. The beads were then made of glass—a glass easily melted and made a little bluish, being drawn into tubes, which were called *girasols* (the word signifying opal). From these tubes hollow globules were blown, and they were then covered on the inside with a solution of isinglass and the pearl essence, which was blown in warm and spread over the internal surface by rapid motion. When dry, the globules were filled with wax, bored through with a needle, and strung on threads. These beads are still made of all shapes and sizes, and many of the most perfect imitations are sold at good prices. The bleak is a fish of about 4 inches long, caught only in fresh water; to obtain a pound of scales, four thousand fish are necessary, and these do not produce four ounces of pearl essence, to preserve which sal ammoniac in solution is used. The optical effect is produced in the same manner as in the real pearl, the grooves of the pearl being represented by the inequalities of the laminæ formed by those particles removed from the scales of the fish.

Class XVI.—Musical Instruments.

Number of Exhibitors, 94.

Situation of Class.—*This Class is on the north side of the Nave, and eastward of the Central Avenue—Japan, China, and the Ionian Islands being on the north and Furniture on the east.*

Position of Groups.—Pianos are arranged generally near the Nave; wind instruments behind; organs are distributed over the building.



PIANOS, PIANINOS AND THEIR PARTS.

Exhibitors.—R. Allison and Sons (3360), Bates and Sons (3362), W. Bond (3367), J. Brinsmead (3370 and 3371), J. Broadwood and Sons (3372), H. Brooks and Co. (3373), C. Cadby (3375), Challen and Son (3377), Chappell and Co. (3379), Collard and Co. (3383), F. Cons (3384), C. Cook (3385), C. Coxhead (3387), A. Dimoline (3391), Duff and Co. (3394), W. Eavestaff (3395), W. G. Eavestaff (3396), J. French (3399), J. Geary (3400), C. Glassbarrow (3401), Greiner and Co. (3404), C. Hampton (3405), W. Holderness (3409), J. Holman (3410), J. Hopkinson (3412), Ivory and Co. (3415), Jackson and Co. (3416), C Kind (3417), Kirkman and Son (3418), Knoll and Co. (3419), Luff and Son (3423), Matthews and Sons (3424), J. Moore (3427), G. Murphy (3428), Oetzman and Co. (3430), G. Peachey (3431), F. Priestley (3433), G. Russell (3436), Rüst and Co. (3437), Shaw and Son (3439), W. Sparks (3441), H. Thompson (3443), W. Turnbull (3444), H. Ward (3446), W. Williams (3447), Wornum and Sons (3450), Cohlman and Son (3452), Nutting and Co. (3453).

The instruments exhibited in greatest number in this class are various descriptions of the piano, a short account of the history of which, from the ancient harpsichord, may not be out of place.

The harpsichords in use in England during the sixteenth and seventeenth centuries, were imported from Holland, where they were made by the celebrated Jean Rückers, and his son, the latter of whom subsequently improved considerably upon his father's instruments, and employed some of the most distinguished of the Flemish artists to ornament the panels. Specimens of these instruments, bearing date 1559 to 1620, existed as late as the end of the last century. The tone of these instruments was soft and silvery, and the construction very simple. Two strings were tuned in unison, while a third —attached to a separateb ridge on the sounding-board—was tuned an octave above. In three pieces of wood, called "jacks," were inserted quills resting on the same key, which, when pressed down, caused the strings to be "twanged" by the quills, producing the combined sound of unisons and octave. These harpsichords had usually two rows of keys, the upper row communciating merely with a single unison string, the lower with three strings simultaneously, which was then the only method for augmenting and diminishing the volume of sound *ad libitum*.

One Tabel, a Fleming, is supposed to have been the first manufacturer of harpsichords in England; he had practised, at Antwerp, with the successors of Rückers, and lived in England between 1680 and 1720.

Jacob Kirkman, a German, and Burkhardt Tschudi, a

Swiss, were apprenticed to Tabel, and after his death established themselves in London; Tschudi was succeeded in his business by his son-in-law, John Broadwood, the founder of the now celebrated house.

Tschudi's fame soon spread over the Continent, and in 1757 he is reported to have sent Frederick the Great a grand harpsichord, which a few years ago was still in existence at Potsdam. The spinet, or epinette, was the origin of the square pianoforte, the first of which was brought to England by one John Zumpe, in 1768. Zumpe had invented a mechanism by which, instead of "twanging" the strings with quills, he struck them with a hammer, which enabled the player to modify the strength of tone at will; and hence the original name of "forte-piano." Many improvements were made upon this construction by Broadwood, but the prejudice in favour of the wiry sound of the harpsichord was so strong that they at first met with universal opposition.

To William Southwell, of Dublin, in connection with Broadwood, we owe the first "vertical," or "cabinet" pianoforte. The grand pianoforte was the invention of a Dutchman, Americus Backers, who in 1767 planned the first instrument of this kind. His original plan was to cause the strings to be struck by soft wood or cork, to adhere as much as possible to the tone of the harpsichord, but subsequently he applied a thin covering of leather to the hammers, which gradually came into universal use. After his death this plan was much improved upon by Robert Stodart.

With the exception of some modifications of Backer's mechanism, to give greater rapidity of execution, nothing has been done to change in any material degree the internal construction of the pianoforte, although great progress has been made in the construction of details, such as the action of the "dampers," the appliances through which they are controlled, and the construction of the "loud" and "soft" pedals.

The pianoforte consists of four distinct parts, viz:—the framing, the stringing, the sound-board, and the action, *i.e.* the keys and machinery for striking the strings. The framing or body of the piano is of great importance, as upon it depends the quality of the tone, the durability of the instrument, and the power of remaining in tune for a greater or less length of time. The framing serves to keep the strings stretched, and as the aggregate tension of the strings in a full-sized pianoforte amounts to from fifteen to sixteen tons, the importance of a strong framing will be easily understood. In the early days of pianoforte-making, the framing was made of wood, the ends of the strings being fastened to pieces of timber at each end. These were supported by a framework of wood, so constructed as to offer the greatest resistance to the strain of the strings, in spite of which, however, it was found liable to bend and become distorted, materially affecting the equality of sound. This defect caused the first attempts for making pianos with metal frames, which were successful in 1820, when Messrs. Stodart perfected the invention of one of their workmen. The studs upon which the back ends of the strings were secured, instead of being driven into the wooden "string-block" as formerly, were now attached to an iron plate curved to the form of the concave side of the instrument, and called the string plate. From this plate metallic bars were extended longitudinally above the strings, reaching to the string plate and wrest-plank respectively, and taking upon themselves, in a great measure, the force of tension of the strings. At the same time, the string plate being attached to the timber framing below, and the metallic bars being also secured thereto, at intervals in their length, the whole formed one strong combined trussing, in which both wood and iron contributed to the strength of the whole. The result of this was, that the strings could be increased in size, and the tone improved in proportion. This plan also contained a "compensating principle," since, however, found to be unnecessary. The material used in their manufacture is the best cast steel, and they vary in diameter from 1·30 to 1·20 of an inch. For the seventeen lowest notes, strings covered with silver or copper wire are used.

THE SOUND-BOARD.

This is of the greatest importance, as the strings, though they would sound the note without it would have but little power. It is generally a board of 5-16ths of an inch thick, of the best Swiss pine, quite free from knots and imperfections, and thoroughly seasoned, and is placed under the strings so that the grain of the wood may lie obliquely across the instrument, and the several widths are cemented together with the finest glue.

The *action* is the machinery through which the impulse given by the finger of the performer is transmitted to the string. The first improvement on this mechanism was called the *single action*; it consisted of a wooden hammer so placed, that when the key was pressed down to its lowest point, the hammer was still a short space from the string. When the impulse given to the hammer had caused it to strike the string, it fell back and left the string free to vibrate. The objection to this action was, that from the position of the hammer it required a strong blow to raise it sufficiently to touch the string: this defect was remedied by the introduction of the hopper, which is so constructed as to lift the hammer nearly to the wire, and let it fall back at the moment of striking, and so leaving the string free to vibrate.

The next improvement, the "check," was designed to prevent the hammer from rebounding and spoiling the sound after having touched the wire, and is considered of the greatest importance.

The above are the chief improvements made in the manufacture of pianos.

Messrs. Broadwood and Sons, the most eminent exhibitors of pianos, to whose house we owe many of the improvements above detailed, exhibit four "grand concert pianofortes," which illustrate all the newest inventions, and for softness of tone and durability, surpass all other instruments in the exhibition. Besides these, Messrs. Broadwood and Sons exhibit models of various parts of an ordinary "drawing-room piano," an "iron grand" ditto, and a model illustrating the principles of stringing.

Messrs. Collard and Collard have also a fine display of their instruments. Among these are, an elegant "concert grand," of seven octaves, A to A, with patent repetition action. The action of this piano is illustrated by a model, and is deserving of notice as showing few centres of friction and great simplicity. A Spanish mahogany "square semi-grand," of $6\frac{7}{8}$ octaves, C to A, with patent repetition action, and transverse bass strings. This instrument is made for exportation to tropical climates, and is constructed with a view to resist the influence of heat, without the usual assistance of glue. A most elegant "oblique grand pianoforte," of $6\frac{7}{8}$ octaves, C to A. The case of this instrument is of Italian walnut, and is richly carved and gilt *à la* Louis XVI.

Messrs. Kirkman and Co. exhibit a "concert grand pianoforte," with seven octaves, A to A, combining all the latest improvements in its interior mechanism. The case of this piano, which is of rosewood, and most elaborately carved, was made at Madras, and is a most magnificent specimen of the skill of native workmen. It is exhibited in the Indian Court.

THE "SIREN" PIANOFORTE.

Exhibitor—F. Priestley.

These instruments, although extremely small, being only 20 inches from back to front, and 3 feet 4 inches high, have a key-board of full scale. The invention consists in suspending the sounding-board in so small a space and in such a manner as to produce the necessary vibration, and consequently develop the requisite quality of tone; and in the simplicity of the action, which considerably reduces the cost of construction.

THE DOUBLE TENSION OR COMPRESSED PIANOFORTE.

Exhibitor—C. Hampton.

This invention consists partly in the arrangement of five metallic tubes, but mainly in the application of a pressure of five tons, in the direction of the strings (or more than the tension at concert pitch), which pressure is applied before any of the details are affixed, and retained until the instrument is strung and tuned.

The advantages said to be secured by this plan are important:—

1st. It is compensating, and will not rise and fall with any change of weather, inasmuch as the tubes being metallic, and in the same direction with the strings, will expand and contract equally with them.

2nd. There is no "setting" in the groundwork of the instrument, by the pull of the strings, as it has been from the commencement subjected to greater tension than the strain of the strings. By these means, the original quality of tone is retained, and the instrument is fit for use immediately after its manufacture, instead of, as heretofore, having to be kept until "settled."

W. and J. Bond exhibit a new construction of "wrest-plank," by which increased length of strings is obtained, producing a more powerful tone in a short instrument, and obviating the necessity of an oblique frame, &c.

Greater power of resistance to the strain of the wires is also offered by this construction, which is as follows:—

The tuning pins being placed upon the top of the wrest-plank will reduce the strain at least one half, by passing over the front at a sharp angle; thus, the greater the compression by tension, the greater the resistance offered by this new construction of wrest-plank.

THE "TUBULAR" PIANOFORTE.

Exhibitors—Rüst and Co.

This instrument has several tubes running perpendicular with the strings; these have a great effect in lengthening the duration of the sound of the notes. The sounding-board is perforated with holes corresponding with the number of tubes. The soft pedal is thrown up between the hammers and the strings: this not only produces a finer tone for the time, but is likely to have the effect of making the instrument last considerably longer than those in ordinary use, besides saving the expense of frequent tuning. The action is of the check description: the dampers are carried outside the hammer-rail, and consequently not liable to cause the disagreeable rattle usual with some of the pianos in common use.

It has a receding front, entirely obviating the obstruction to the voice in singing, usual with all other upright pianofortes, and an improved desk, of the entire width of the instrument—with or without extending ends—so that not only can two or three performers (in duets and trios) have each their separate parts immediately before them—an advantage obvious to every musician—but also (with the extending ends) an accompanyist at each end of the pianoforte.

Another class of piano, exhibited by J. Brinsmead, is also deserving of notice on account of a new repeating action of great simplicity, and very good tone.

Another form of piano, and one that will be found of use where space is an object, is a square pianoforte, in mahogany, exhibited by Wornum and Son. It is mounted in a frame upon centres, allowing the instrument, when not required, to be turned upright, so as to occupy a very small space. When upright, it is but 21 inches deep, and may be easily moved.

ORGANS AND HARMONIUMS.

Exhibitors—**Bevington and Sons (3366), Boosey and Co. (3368), C. Cadby (3375), Chappell and Co. (3379), R. Chidley (3381) J. Fincham (3397), Forster and Andrews (3398), Imhof and Co. (3414), T. Robson (3434), J. Walker (3445), H. Willis (3448), Bates and Son (3451), G. Stidolph (3454).**

The organ exhibited by Forster and Andrews is one of the largest in the Exhibition. The movements of this organ are principally direct action. The great and pedal organs are supplied with improved pneumatic movements, which also act upon the whole of the couplets. The bellows are blown by Joy's patent hydraulic engines, supplying wind to the respective portions of the organ at four different pressures, the heaviest of which is nine inches. The scales of the flue pipes are by Professor Töpfer, of Weimar, on the proportion of $1 : \sqrt{8}$; this arrangement is to obviate a weakness sometimes noticed in the treble part of these instruments. The wood pipes, from the four-feet pipe upwards, are of Swiss pine. The ophicleide tubes are terminated with "bells," like the instruments they imitate. The lower notes of the pedal trombone have pneumatic valves acting on the tongues, to enable them to speak instantaneously. The large pedal open diapason, and the sixteen-feet metal double diapason, are supplied with wind from conical valves applied under the feet; the latter form was first adopted by this firm in 1850. The other organs, which are to be found in various parts of the Building, are remarkable as careful examples of organ-building; some of them have an improved machinery which would well deserve notice did the space at our disposal allow of it. As all persons have an opportunity of hearing them, the organs must speak for themselves. For WILLIS'S ORGAN see page 139.

HARMONIUMS.

Exhibitors.—Chappell and Co.

The harmonium is provided with keys similar to an organ, the compass ranging from four to six octaves, but generally confined to five. These are however virtually converted into seven by the perfect arrangement of the registers or stops adopted in the better class of instruments. The sound is produced by a current of air causing metal "tongues" to vibrate between the edges of brass boxes. The air is forced through the boxes containing the tongues by means of pipes, closed at will by "pallets." The "wind" part of the instrument is as follows:—The air is forced by "feeders" into the reservoir, which descends and is raised by spiral springs, thus forcing the air into the sounding parts. By these means a continuous supply of air is provided—a great desideratum in playing slow music; but for music of a more varied character the reservoir is defective, to remedy which the "expression movement" has been invented, which is one of the most important features of the instrument. This "movement" cuts off the connection between the feeders and the reservoir, and allows the air to pass unimpeded from the feeders to the sounding portions of the harmonium. It will be seen at once that great care is required in the use of this mechanism, to prevent the instrument from appearing to gasp for breath while it is drawn.

Many attempts have been made to do away with this mechanism; but the result is, that the instrument is no longer a harmonium, but a seraphine or reed organ, having no power of expression.

Messrs. Chappell's large harmonium has two complete manuals, ranging from C C to C^4, having also a pedal organ, two octaves and a half in compass: it contains nine and a half rows of vibrators on the manuals, and five rows on the pedals. The great feature of this instrument is, that it can be used either as an organ or a harmonium, having a pair of harmonium treddles which open out from the front of the instrument, and coming over the organ pedals. These treddles being shut up, wind can be supplied by another person and the instrument used as an organ.

Messrs. Boosey and Ching exhibit some of these instruments, in which they have introduced various improvements. The most important is a "large pedal organ harmonium," in carved oak case, with two rows of keys, and two-and-a-third octaves of pedals. It has independent reeds, and thirty-two and sixteen-feet scales. The upper row of keys represents the "swell," and the lower row the great organ.

VIOLINS, WIND INSTRUMENTS, AND DRUMS.

Exhibitors—T. Allwood (3361), J. Bell (3363), F. Besson (3364), A. Betts (3365), Boosey and Sons (3369), G. Butler (3374), E. Card (3376), A. Chappell (3378), E. Chidley (3380), Clinton and Co. (3382), E. Corfe (3386), T. Croger (3388), J. Davis (3389), M. Dearlove (3390), H. Distin (3392), J. Dodd (3393), T. Glen (3402), E. Greaves (3403), J. Higham (3407), W. Hill (3408), T. Hopkins (3411), W. Hughes (3413), J. Köhler

(3420), L. Lachenal (3421), E. Locke (3422), G. Metzler (3425), J. Oates (3429), H. Potter (3432), Rudall and Co. (3435), T. T. Scowen (3438), J. Simpson (3440), J. Starck (3442), W. Wilson (3449).

TRANPOSITION CORNET.

Exhibitor—F. Besson.

This is a cornet in B flat, and the exhibitor claims for it the merit of perfection. From the construction of the register, the player is said to be able to play the most difficult music, and to change instantly from one key to another. This system is applicable in the construction of all three-piston instruments.

"CHALLENGE" CORNET-A-PISTON, WITH THE "CHAMPION" VALVES.

Exhibitor—J. Oates.

The peculiar excellence of this instrument consists in the arrangement of the wind passages through the pistons, which have each an inclination of only one-third of a diameter from the straight line, and are consequently all alike, producing a perfect homogeneity of tone and tune throughout the whole range of the instrument.

There is also a great improvement in the method of connecting the valves by means of curved instead of straight tubes, as also in the arrangement of the "water exit."

The wind instruments exhibited by Messrs. Boosey and Sons are deserving of notice. An instrument introduced by them is the "basso profondo;" it is a double-slide contra-bass trombone, in B flat. This instrument first attracted attention at the Crystal Palace brass-band contest in 1861, and from its brilliancy and depth of tone promises to become universally adopted. Although bombardons in B flat are occasionally made, they are of great weight, and require great strength of lungs in the performer: the instrument exhibited by Boosey and Sons only weighs a little beyond eight pounds, and is played with but little exertion.

H. Potter also exhibits a number of wind instruments; the best of these are—

The improved concert flutes which have a perfect C flat, and greatly improved upper notes. Great equality of sound is obtained without alteration of the fingering.

The improved oboe, of good sound simple mechanism, and very easy fingering; and a cornet and bombardon, with improved valve system for equalising the tone of the valve and open notes.

The sonorophon, exhibited by Metzler and Co., is deserving of notice. The deep sounds are produced by the construction of the "bell," and the absence of all sharp angles in the winding. This instrument is well adapted for the use of cavalry bands, as it is very compact, and hangs in front instead of at the side of the performer. Various brass instruments on the same principle are shown by these exhibitors.

A set of solid silver kettle-drums, manufactured by H. Distin (3392) for H.M. 3rd Light Dragoons, show great finish and good workmanship.

FLUTES: WOOD AND METAL.

Exhibitors.—Clinton and Co.

These exhibitors show a fine collection of flutes, among which are specimens of old flutes, showing the gradual improvement which has been made in their construction. They also exhibit flutes of their own construction, and improvements, such as an eight-keyed metal flute, with new key mechanism, designed for tropical climates; also what they term the equisonant flute. This instrument combines many advantages, such as equality of tone and easy fingering.

DOUBLE-BASS, WITH APPARATUS FOR PRODUCING ENHARMONIC SCALES OF HARMONICS.

Exhibitor—T. M Hopkins.

The advantages of this instrument are, that great length of string is obtained, giving both greater power and purity of tone. It has a compass of nearly four octaves, all completely under the control of the performer. The quarter tones are produced by more or less pressure on the keys. Harmonics for each note are produced by pressing up the thumb key.

CONCERTINAS.

The instruments of this kind in use in England are what are called the English concertinas; they are constructëd in some respects like the German concertinas, but differ from these in certain important features, viz., sound and compass. The latter is generally about three-and-a-half octaves from G below, to C above the stave. The sound is produced by a current of air being forced through small metal tongues fixed in metal boxes, and called vibrators. Double sets of these are made to each note, causing it to be sounded whether the bellows be drawn out or pushed in.

The concertina has only become known within the last thirty years, and until lately was subject to many imperfections; but recent improvements, and its adoption by such artists as Signor Regondi, have caused it to become better known, and will probably soon make it universal. There are three kinds of concertina—the treble, the baritone, and the bass.

The treble is well adapted for music written for the violin or voice, and admits of the most difficult passages; the two latter, though fuller in sound, are more adapted for music of a solemn description.

The best makers of these instruments are E. Chidley and L. Lachenal, who contribute some fine specimens; the former particularly shows some bass and baritones.

T. Croger contributes some specimens of a musical instrument which is perhaps one of the oldest and most charming, although the music to be performed is entirely out of human control,—viz., the Æolian harp. It consists of a framework of wood, across which are stretched some gut strings which may be tuned at pleasure. To make it play, it need merely be suspended in a position where it is exposed to the wind, and it will emit the most wildly charming sounds. This instrument used to be met with in the embrasures of ruined castles, and has added much to the romance attaching to these places.

MUSICAL STRINGS, &c.

Exhibitor—E. Corfe.

This exhibitor shows samples of metal strings of good quality, also improved flute cleaners.

DESCRIPTION OF WILLIS'S ORGAN.

This instrument stands in the Gallery, at the south end of the East Transept. It possesses four rows of keys, two and a half octaves of pedals, and is prepared for eighty stops, including couplers; of these there are at present forty-one of the stops playable, viz.: in the great organ fourteen, swell organ ten, pedal organ seven, solo organ seven, choir organ three. Its prodigious effect is due to a novel construction of valve, which has enabled the builder to throw into the pipes air at a great pressure. He is further assisted by the pneumatic lever, which is so applied as to render it impossible for the performer to detect the fact, that an intermediary power exists between his finger and the valves under the pipes. By this arrangement many valves can be opened without effort; and consequently very many pipes be made to speak at the same time.

There are also in this instrument several novel inventions, and amongst them, a very beautiful application of the pneumatic lever, which enables the performer to produce a crescendo and diminuendo on the swell organ by means of his breath. The stops are combined in no less than twenty-four changes by pneumatic power, brought into action by the finger or thumbs of the player. Part of the pedal organ is constructed with a quicksilver valve, the property of which is to offer no resisting surface to the pressure of the air. The instrument altogether is arranged either to form the nucleus of a mighty organ, or to come apart and form several small organs.

CLASS XXX.—FURNITURE AND UPHOLSTERY, INCLUDING PAPER-HANGINGS AND PAPIER-MACHÉ.

Section *a.*—FURNITURE AND UPHOLSTERY.
" *b.*—PAPER-HANGINGS AND GENERAL DECORATIONS.

Number of Exhibitors, 262.

SITUATION OF CLASS.—*This large Class extends from the Colonies on the North side of the Nave to the stairs, which separate it from the Class devoted to Music. It comprehends several Courts from the Nave to the wall of the Refreshment Department.*

The confined limits of space to which we are reduced, compels the omission of the names of the exhibitors here.

INTRODUCTORY REMARKS.

THE laws which govern that which is commonly called "taste" are far more arbitrary than people usually imagine, and depend upon certain rules as stringent as those which preside over the sciences generally, only being more subtle they escape the ordinary power of analysis. Were it possible to define, to classify, and arrange these governing powers, it would be found that the most delicate forms of beauty are amenable to them, and probably one of these days we may arrive at a far better comprehension of the principles involved than we at present possess. "Outline" is doubtless subservient to the laws of geometry, plane and solid; "colour" to the harmonious vibrations on the nerves of the eye; "design" to combinations too involved to enumerate; and even ascending into the more rarefied regions of imagination and fancy, we shall find that they also are subject to strict governing principles, which, though more difficult to define, nevertheless exist in equal power and intensity with the others. It is probable that every curve, however seemingly simple, which the artist or the artizan uses, bears a distinct relation to its fellows, and an incongruity in its position produces to the educated eye a disagreeable impression, which is owing to an infringement of some principle of harmony too delicate for us to grasp.

In drawing the reader's attention to the various articles of decoration in the present Exhibition, we must ask those who follow us to bear these few facts in mind, and especially to remember that incongruity is more fatal to the beautiful than any other description of error; and a man may waste a lifetime in labour lost if he forgets that harmony of parts, even in the minutest degree, is first and foremost in the creation of a work of art, whether it consists of the humble utensil for domestic use, or those purely Fine-Art productions in which creative genius and the highest order of intelligence are necessary.

In a book of this description a lengthened notice of any of the objects in the Exhibition is impossible; nor do we desire to anticipate the judgment of the juries who will pronounce upon the merits of the various productions by a critical survey, but at the same time we select those articles which we consider entitled to especial notice, so that the visitor may examine and judge for himself.*

FURNITURE AND UPHOLSTERY.

It has been found impossible to adhere strictly to the system of grouping, as it respects furniture, which has been observed in other divisions of this publication. The exhibitors of tables also exhibit sideboards, &c.; consequently the names would have to be repeated unnecessarily if this plan were adopted. Furniture in its strict sense will, however, be separated from mere wall decoration, and papier-mâché will be treated as a peculiar manufacture. Many other points, as marqueterie, parqueterie, buhl, and reisner work, will be sufficiently explained under their respective heads. Paper-hangings will also form a separate section, and the manufacture of the different varieties will be carefully described. It is thought desirable in the first place to select a few of the more remarkable groups for general description.

The articles (No. 5677) exhibited by M. Brunswick, of

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* This was written before the publication of the Jury Awards.—R. H.

Newman Street, are a cabinet in the style of Louis XVI., in marquetry of Indian tortoise-shell and brass. The lower part is a table with drawers, and a writing tablet; the upper part, resting on a plinth, contains drawers which open with secret springs, and is crowned with a cornice.—A cabinet in the same style, of Amboyna wood.—A cabinet of ebony and ivory, in the style of the 17th century; the doors in the upper part are decorated with inlaid ivory, and engraved ivory panels containing subjects from Raphael: and the lower part consists of a table, supported on a plinth and columns ornamented with ivory.—An octagon table, in modern style; the marqueterie on the top is composed of various subjects, and the moulding which encircles it is enriched with inlaid lapis lazuli. The legs are richly mounted.

Cox and Son, of Southampton Street, exhibit (No. 5690) in the Mediæval Court, a richly-carved reredos, executed in the rough, to show what can be done by machinery. It consists of five compartments, with ogee projecting crocketed canopies and tracery: the crockets, finials, and pinnacles, are formed of the shrubs, leaves, flowers, and fruit of British plants and trees. The lower panels are filled with tracery, having the leaves of the passion-flower in the spandrils, and its flower supporting a crown of thorns on the cusps. The upper panels contain the Commandments, the Lord's Prayer, &c., in relief, the centre one having a scroll with an inscription richly illuminated in colour, on a gold ground.—A table divided into three compartments: all the spandrils and cusps have natural foliage richly carved; each panel of tracery, supported on clustered columns, is surmounted by deeply-relieved mouldings; and, in place of the usual hood-mold, palm branches, which partly conceal the mouldings, are introduced. Behind the oak-work, and appearing through the tracery, is a background of crimson Utrecht velvet, containing enrichments. A cavetto cupping, with vine leaves and grapes, crowns the table.

The articles (No. 5691) exhibited by W. Andrews, King's Row, are specimens of turnery in wood, under glass shades: stands in sycamore and ebony, for artificial flowers and wax fruit; ornaments for the table or chimney-piece; and stands and vases in satin-wood, &c., for the drawing-room.

Among the contributions (No. 5721) by Messrs. Filmer and Son, Berners Street, are a circular extending dining-table, of English pollard oak. The framework is of Italian design, with scroll supports, ornamented with festoons of flowers, &c. It is made to open so as, at all sizes, to preserve the circular form, the top remaining entire during the extension of the framework, and quarter circles being introduced in several series. The whole framework is expanded simultaneously by means of a screw-and-cog mechanism, which is under the control of one person, who may thus, in a few moments, lay a dining-table large enough for thirty or forty persons.—A moveable convertible ottoman, which is made in four parts that fit together, but which may be instantly converted into two easy-chairs and two settees. The groundwork is finished in white enamel, with mat and burnished gold relief: the covering is a rich figured silk; and the carving, which is extremely simple, is in the style of Louis XVI.

T. Fox, Bishopsgate Street, exhibits (No. 5724) a console cabinet of walnut, inlaid with holly. The lower part is fitted with shelves covered with velvet; and figured grass panels are introduced behind the pilasters, to soften the light. The upper part consists of small side cabinets, surmounted by shelves for articles of virtù, and the back is of silvered glass. A cabinet, en suite, is intended for the centre of the room, and hence is of transparent glass, that it may cause no obstruction to the general arrangements of the apartment. There are other articles, also en suite. The chief peculiarities in these specimens consist in the method of veneering the excentric curved mouldings—the several contractions and expansions being produced in the width of an inch by the aid of *elastic cauls.*

George, Clement, and Son exhibit (No. 5730) a carved oak sideboard, in the Italian style.

Among the articles exhibited by W. Holland, Warwick, are (No. 5746) table tops, painted in imitation of Italian marbles in the Florentine style; model doors, painted in marqueterie style; patterns of stained marqueterie for doors; and specimens of various woods and marbles.

The articles (No. 5761) exhibited by T. H. Kendall, Chapel Street, Warwick, are two ebony china cases, ornamented with elaborately-carved panels, relieved by smaller ones of Rosso antiquo and other marbles, taken from the ruins of a house on the Via Appia, at Rome. One of these contains a panel carved in lime-tree—and it is very rare to find so large a piece of this wood, free from blemish; the subject is "dead game," and the details have been brought out with great truthfulness and care.—A table in the Cinque-Cento style, richly carved, and made of the wood of one of the celebrated cedars grown in the grounds of Warwick Castle.—And a large oak fire-screen carved in the Renaissance style.

J. M. Levien exhibits (No. 5771) a sideboard of New Zealand wood, in the renaissance style; its richly-carved back is ornamented with flowers and fruit.—A cabinet, in the Pompeian style; it is formed of various woods, inlaid with ivory and ebony.—A cabinet inlaid with plaques of Sèvres china, and ornamented with ormolu.

Litchfield and Radcliffe, Hanway Street, exhibit (No. 5772) a fine old Venetian looking-glass, adapted as a cheval glass by an ebony stand, carved, and inlaid with ivory, &c.—An upright cabinet of carved ebony and ivory; the doors are inlaid with cornelians: the columns, plinths &c., are of marble: the inside is lined with silvered glass, and decorated with groups, and specimens of Sèvres, Dresden, and other celebrated porcelain.—Large ebony tables, inlaid with ivory.

A sideboard (No. 5779) is exhibited by D. J. McLauchlan and Sons. It is of wainscot oak, richly carved and gilt. The two cupboards are rounded to the wall: and the space between them, and under the drawers, is left open, looking-glass panels being placed at the back. The cupboard doors contain two small panels enriched with fruit: and a portion of the centre frame is decorated with dog-tooth moulding Above the sideboard are three plates of looking-glass, united in a bold frame, their extreme dimensions being 13 feet 4 inches height, 9 feet 6 inches width, and 2 feet 8 inches projection. Over the centre plate, is a large round arch, of considerable projection; and the side glasses are covered with small flat canopies rounded to the wall. The arch is supported, at the divisions between the glasses, by brackets resting on twisted columns; and from the standards which support the columns, rise brass branches terminating in globes, which may be used for gas or oil lights. The ornaments consist in the adaptation of about twenty different kinds of natural foliage, chiefly British; the gilding has been done in various ways, being posted, dead, and burnished: and engraved and burnished decorations are used to relieve the flat surfaces.

Jackson and Graham, Oxford Street, exhibit (No. 5751) decorations for the side or end of a drawing-room, in the style of Louis XVI., panelled and enriched with mouldings, and relief ornaments, gilt. The centre panel consists of silvered plate-glass, and the side panels of rich crimson silk.—A chimney-piece of Algerian onyx: the pilasters and frieze enriched with bas-reliefs of bronze, chased and gilt.—A cabinet of ebony inlaid with ivory. The centre is enclosed by doors, which contain oval medallions, in bronze, chased and gilt: the ends are open and rounded: the plinth, columns, and frieze are enriched with mouldings and ornaments of bronze, chased and gilt: and the whole is surmounted by a slab of Algerian onyx.

Much of the furniture exhibited affords examples of BUHL, REISNER, MARQUETERIE, and PARQUETERIE. Some explanation is required.

In France, Boule, or Buhl, and Reisner, were two celebrated cabinet-makers, who have given their names to peculiar varieties of inlaid work which are well known. Buhl was born in 1642, and died in 1732. He was appointed to an office, "Tapissier en titre du Roi." Reisner, in the succeeding generation, was appointed "Ebeniste de Louis XVI." Buhl-work consists of inlaid veneers, and differs from marqueterie in being confined to decorative scroll-work, frequently in metal;

while the latter is more commonly used for the representation of flowers and foliage. Reisner's work was of the most exquisite finish, both of adjustment and surface. His woods are frequently stained, but never to such an extent as to mask the play of light in the fibre. D'Alembert says the wood forming the base of the marqueterie was not cut down for the insertion of the ornament until after the veneer had been glued down to the surface of the work. This enabled the ornament to be sawn out rather full and then adjusted to a microscopic joint by filing down the edges. It was in this way that those extraordinary fine lines, too thin for the passage of any saw, were obtained, which seem so astonishing in the joints of Reisner's finest work.

Mosaics in wood were introduced for flooring probably about the same time as marqueterie became employed for altar decoration. Floors of this description are usually termed *parqueterie*, from the French *parquet*. Elms, in his definition of the term says, "A species of joinery or cabinet work, consisting in making an inlaid floor, composed of small pieces of wood of defferent figures." Since the term *parquet* signifies the bar in a Court of Justice, and the place close to the pulpit where the ministers and elders of a French Protestant church sit together, parqueterie has been thought to owe its name to the fact of the flooring of these parts—the most sacred being formed of inlaid woods. The name may, however, be derived from *parquer*, to pen up, as indicating the mode in which the pieces were fastened together. Marqueterie is, however commonly applied to the inlaying of woods for the decoration of furniture, and representing generally fruit and flowers; while parqueterie is used almost exclusively to signify wood mosaic flooring, or similar decorations, applied to the sides of an apartment. Usually, parqueterie, or parquetry, consists of thin pieces of differently-coloured woods, veneered upon some less expensive material. The cost of this kind of work was considerable, and its durability not great, owing to the thinness of the veneer, and the liability of it to break away from its base.

The attention of visitors is directed to the solid Swiss parqueterie exhibited in the Nave by the Messrs. H. and A. Arrowsmith, of Bond Street. This manufacture is made solid throughout, and every portion of the ornamental woods which form the patterns is grooved and tongued together, and fastened with marine glue. This admits of its being fixed at once upon the joists when used for flooring. This parqueterie, as its name indicates, is constructed in Switzerland. By steam saw-mills, and other machinery, the pieces of wood are cut, about 1 inch in thickness, and of the required shape; these are carefully tongued into one another, and, where it is possible, grooved together: in many cases solid lines of the pattern running through all the work. In this way the utmost degree of solidity is given to the parqueterie. In France, this new manufacture is largely employed; the châlet at the Bois de Boulogne, near Paris, is fitted up with it; and the apartments at St. Cloud, which were occupied by the Queen and her late Consort, during their visit to the Emperor of the French, were fitted up with the Swiss parqueterie.

Among the articles (No. 5816) sent by A Sedley and Co., is a sideboard in brown and light oak, in the Italo-Elizabethan style. The panels are richly carved—the subjects being game: the brackets consist of foxes' heads; and the back is a large silvered plate of glass.

Taylor and Son, of Princes Street, Edinburgh, exhibit (No. 5834) a sideboard, with a sarcophagus wine-cooler, in Italian walnut, and in the Italian style. The back of the sideboard is in three compartments, of which that in the centre, a niche, contains a figure having a falcon perched on its left hand, and a dead heron in its right. The compartments are separated and bounded by pilasters and trusses, surmounted by an enriched cornice: and on the four pilasters are placed heads representing the seasons. Within are carved brackets, holding bronze vases: under the brackets are six panels filled with foliated heads: and above are panels containing groups of fruit. The slab is decorated with carved mouldings, and is supported by massive trusses and bacchanalian masks: cereals run down the centre of the mouldings. The wine-cooler is enriched with tracery intermixed with the vine, and elaborate mouldings. They exhibit also a cabinet of the same material, and in the same style.

The Messrs. Trapnell, St. James's, Barton, Bristol, have sent a sideboard of Riga oak (No. 5840), in the Italian style. The back, which is supported by carved columns, is divided into three compartments: that in the centre, of plate-glass, is enriched with mouldings: and those at the sides are highly-finished arabesque panels. The front is supported by four lions; and the mouldings, frieze, &c., are elaborately carved.—A cabinet of foreign walnut, mounted with ormolu mouldings. The back is of plate-glass; and the front is formed into three compartments by four caryatides. The interior is lined with sycamore, and the shelves are covered with velvet.

W. Wallis exhibits (No. 5849) wood carvings from nature. Dead game, and living birds, shrubs, and trees, with rural adjuncts, are grouped together with great taste, and executed with extraordinary truthfulness and skill. The head of a youth, in alto-relievo, in a circular panel, has been executed with much care and success.

P. Wertheimer, New Bond Street, exhibits a console table (No. 5852), in the style of Louis XVI. Chased rosettes of mat gold are mounted in a metallic steeled border, in the centre of which is a head crowned with ivy leaves, from which spring garlands of laurel leaves. The scroll feet are richly ornamented in a suitable style. At the base is a vase in steeled and mat gold: from the handles spring garlands of oak leaves. The top is of an Italian marble.—A small cabinet, in the same style: the mountings are of mat gold, and delicately finished; and the upper portion is supported by pilasters.

S. Warne, Bruton Street, exhibits (No. 5931) a circular ottoman, covered with Spitalfields silk: the buhl-mounted centre is filled with artificial flowers.—Paper-hangings and borders, designed and block printed in London.

Wright and Mansfield, Portland Street, exhibit (No. 5862) a carved cabinet in the style of the 18th century, with plaques of Wedgwood ware in the panels and frieze.—A chimney-piece and glass—the frame of wood, in the same style. The medallions in the frieze are of black Wedgwood ware.—Also book-cases (especially one, of the most harmonious design) of a similar kind: and a specimen of room decoration, in the English style of the 18th century.

Bird and Hull, King Street, Manchester, exhibit (No. 5670) a bed-room suite in common sycamore and alder—the object being to show what may be done with ordinary materials. —A cabinet of black ebony, enriched with carvings in white holly.

Howard and Son, Berners Street, have sent (No. 5748) a book-case, in which carved, coloured, and gilt decorations have been introduced; and an attempt has been made to accommodate ancient ornaments to modern purposes.

T. Wright, George's Street, Bath, exhibits (No. 5763) a writing-table supported by pedestals of oak and ebony, and decorated with carved lions' heads, &c. On this table is placed a cabinet, the centre portion of which is a desk, that, when shut, forms a panel ornamented with malachite, lapis lazuli, cornelian, &c. Both table and desk are enriched with ormolu pearl-beading.—A solid ebony drawing-room chair, in the style of Louis XV.

R. Whytock, George Street, Edinburgh, has sent (No. 5855), among other articles, a large English pollard oak sideboard. Massive pillars support the top; a rich veneered panel is fitted into the back: and at each side are carved pilasters and ornamental scrolls. The laurel and oak branches in the end panels are copied from nature. A shaped pediment forms the apex of the back, and at each side are suspended festoons of fruit and flowers.

T. Kershall, Baker Street, exhibits (No. 5903) a drawing-room wall decoration, with panel executed in imitation of silk, by a new process; it is in the style of Louis XVI.—Gothic and Venetian wall decorations.—Imitations of woods, marbles, &c.

The figure of Undine, on an inlaid cabinet (No. 5835), and portions of drawing-room decoration at the back, were designed by the late Mr. John Thomas, as a specimen of sculptured marble, to be introduced into drawing-room decorations. The cabinet was made by Mr. F. Anstey, from the original drawing.

Gillow and Co. exhibit (No. 5731) a solid walnut sideboard in the Renaissance style. The lower part is decorated with carved panels and herons (life size), &c.: the upper part has a large silvered glass, panels containing dead game, and bacchanalian figures holding lamps. Wreathed pillars support an enriched frieze, surmounted by figures holding a chandelier.—An Italian marqueterie cabinet, with elaborately-carved pillars of box-wood. The ends and centre compartments are enclosed by plate-glass; and at each side are doors inlaid with plaques of porcelain, containing paintings.

Among the articles sent by W. Smee and Sons (No. 5820), are a richly-carved walnut-wood cabinet, relieved with tulip-wood: the back is fitted with silvered plate-glass.—A birch and tulip-wood wing-wardrobe: the columns, &c., are carved, and the centre door is fitted with plate-glass.—A birch and tulip-wood toilet table: the looking-glass is supported by cabinets fitted with trays.

Strahan and Co., Henry Street, Dublin, exhibit (No. 5828) a drawing-room cabinet of rosewood, with a slab of Carrara marble, supported by winged caryatides. The panel of the centre door is of plate-glass, decorated in gold scroll, &c.: the side panels are enriched with fret-work, &c. The whole is surmounted by a large mirror with a rosewood frame, carved to represent griffins, &c.—intertwined with foliage in the Italian style.—A walnut circular table: the pillar is surrounded by three winged monsters: the top is inlaid with marqueterie, and the border round it is elaborately carved in scrolls and masks.—A very ingenious walnut chess-table, having a revolving cylinder of glass which covers the chessmen and prevents them from being disturbed during intervals of the game.

J. M'Lachlan, St. James's Street, exhibits (No. 5907) the decorated side of a drawing-room, composed of an enamelled door, wall panels in arabesque, and a dado underneath, framed with ornamental work, burnished and gilt.

Purdie, Cowtan and Co. (5915) exhibit decorations for a drawing-room, consisting of a ceiling in which is depicted "Aurora surrounded with Cupids scattering flowers;" and of panels painted with medallions, emblematic of the seasons. Also (5916) a design for the decoration of a dining-room, in the style of the "Renaissance," to which we direct special attention.

There can be no doubt that the highest and best of all mural decorations consist of pictures painted for the spaces they are to occupy, arranged in compartments, harmonizing with, and forming part of the architectural features of the apartment. In the specimen before us, the frame-work and panels, except those filled with pictures, are executed in imitation of marbles, walnut, ebony and purple woods. The centre tableau is done in oil; the two side pictures in the new style of fresco called the water-glass, dry or stereochromic method. The grounds or tablets are composed of mortar, or Portland cement, mixed with somewhat more than the usual quantity of sand, to render the surface porous. Portland cement has been employed for the two pictures in this decoration; and the colours are mixed with distilled water, applied on the cement tablets when dry, as in distemper painting. The water-glass (silicate of potash) is sprinkled on the painting when finished, and this process fixes the colours. The three pictures filling the panels are copied from the gallery at Hampton Court. Considering the novelty of the method, and the difficulty in such material, of producing the transparent pearly tints of Lely and Kneller, a task of no ordinary difficulty has been accomplished.

Heal and Son (5740) exhibit bed-room furniture in the style of Louis Seize; it is of mahogany, enamelled, ornamented with tracery, and the bed requisites are of a suitable description.

Johnstone and Jeanes (5756) exhibit a cabinet in the Italian style, intended for a drawing-room. It is of walnut, inlaid with a variety of woods, and is surmounted by a lofty glass in three compartments, with a carved, gilded and inlaid frame.

Mr. J. G. Crace (5691) exhibits a mural decoration of a drawing-room, and a trophy in the Nave consisting of very beautiful specimens of Gothic and Italian furniture.

PAPIER-MÂCHÉ.

There are several exhibitors of articles made in this material.

Papier-Mâché may be said to consist of three varieties. 1. Sheets of paper pasted together, exposed to great pressure, and then polished; 2. Sheets of considerable thickness, made from ordinary paper pulp; and 3. Such as enters into the manufacture of the fibrous slab, which is a mixture of paper pulp with some earthy matter.

H. Ogden, Lower King Street, Manchester, exhibits (No. 5789) a pedestal sideboard, in the Renaissance style, made of Dantzic and English oak.—A couch and chairs of walnut-wood, in the style of Louis XVI. These articles are shown as specimens of design and workmanship.

ECCLESIOLOGICAL SOCIETY'S COURT.

This court contains an apartment of decorative articles, chiefly for church purposes, which have been arranged under the supervision of the Ecclesiological Society. In the passage leading from the Nave we find a series of articles in wood and metal work, forming a portion of the Skidmore collection. The principal of these is the metal canopy intended to be placed over the tomb of Bishop Pearson, in Chester Cathedral. It is executed in brass and bronze, coloured and ornamented in a manner similar to the Hereford wood screen already noticed. At the angles are placed four detached pillars supporting allegorical figures, representing—

1. The shield of faith.
2. The helmet of salvation.
3. The sword of the Spirit.
4. The girdle of truth.

All these smaller figures are elaborately executed, and the armour is enriched with jewels. This company also exhibits a case of church plate, very elaborately executed, and a bedstead and sideboard in very early Gothic style.

The contents of the Ecclesiological Society's court are of a very varied character, including stone and wood carvings, metal works, mural decorations, curtains and hangings, tile pavements, furniture, embroidery.—A portion of the series of bench ends, by Mr. Forsyth, for Chichester Cathedral, which have already been noticed in Class X.—Another object referring to Class X. is the model for the sculptured group, to be placed over the doorway of the Digby mortuary chapel, which also has been previously noticed.

Messrs. Cox and Son exhibit an extensive series of articles for church decoration, the principal one being a carved oak reredos, consisting of five canopied panels, having the crockets, spandrils, finials, and pinnacles carved with the leaves and fruit of British plants and trees. The middle rail contains enriched mouldings of the foliage of the maple tree. The lower panels under the outer compartments are filled with tracery, having the leaves of the passion-flower on the spandrils; on the cusps are the flowers themselves, enclosing a crown of thorns, in the centre of which is the sacred monogram. The central upper panel has a cross and scroll with inscription, illuminated in colour on a gold ground; the side panels contain slate tablets, on which the Commandments, the Lord's Prayer, and the Creed are inscribed. The whole of the carving is unfinished; it has been left in the rough state in order to show the character of the work performed by the carving machine. The altar table in front of the reredos is also carved in oak, but in this case the work has been finished by hand; it is divided into an arcade, three panels having the arches filled with tracery of an elaborate character, interspersed with spandrils of natural foliage, and surmounted by palm wreaths springing out of the vases which form the buttresses. There are also twenty small carved capitals, and a richly-carved moulding runs round the edge.

Other works by the same exhibitors are—1. A brass altar rail standard, formed of a vine branch, with fruit and foliage in polished metal, while the stems are left of a dead colour; an iron standard formed of branches of the passion-flower. 2. An eagle desk carved in oak, having an octagon base with crockets formed of natural leaves and flowers intertwined, from which springs a slender shaft; a richly-carved cap representing the fruit and flowers of the horse chestnut, which have been carefully studied from nature. 3. A Caen stone font, consisting of a circular bowl with eight ogee crocketed canopies, on a diaper ground carved from natural foliage, supported by eight angels. The bowl stands on a shaft which is ornamented with eight small marble columns having elaborate shafts and bases. Beside the above, the series includes carpets, hangings, and other smaller decorative articles.

Richly embroidered altar frontals designed for Peterborough Cathedral, and for Clehanger Church, are exhibited by the Ladies' Embroidery Society; and two others by Messrs. Harland and Fisher.

Messrs. Jones and Willis exhibit a large collection of costly silken and woollen damasks, principally from designs by Mr G. E. Street, which are intended for chancel and sanctuary hangings; and various articles embroidered by hand, including a funeral pall, banners, frontals, and alms bags.

Among the carpets exhibited is one by Messrs Harland and Fisher, designed from the pattern represented in a picture by Jan Van Eyck, at Bruges.

Embroidered worsted and serge hangings, of excessively quaint and ancient patterns, are to be found among Messrs. Morris, Marshall and Co.'s collection.

The model of one of the sculptured panels of the Westrop monument to be placed in Limerick Cathedral is exhibited by Mr. W. Redfern; it represents the Entombment: a drawing of the finished design, which is due to Mr. Burges, is placed underneath it.

A work of similar character to that last-mentioned, is the new reredos for Bedminster Church, which is designed by Mr.

J. Norton and executed by Mr. J. Farmer. It consists of three canopied panels enclosing sculptures, representing "The Adoration of the Magi," "The Crucifixion," and "The Ascension." Another sculptured panel of the "Last Supper," forming the central portion of a reredos for Winterbourne Church, Gloucestershire, is due to the same artists.

The "Last Supper" also forms the subject of a reredos by Mr. Earp, from the designs of Mr. Fenton. This work is of an elaborate character, being enclosed by a canopied frame of alabaster, having coloured marble columns with richly sculptured caps. Another work by Mr. Norton is a font in Staffordshire alabaster, having quatrefoiled panels on the sides enclosing sculptured groups in white marble, and figures of the Evangelists at the angles; the base is supported by small columns with coloured marble shafts, and the mouldings are heightened with gilding, producing a rich and beautiful effect.

The reredos designed for Waltham Abbey church by Mr. Burges, contains a large group of the "Adoration of the Magi" in high relief upon a diapered background. It is intended to be executed in alabaster, having the figures and background coloured and gilt, as shown in the finished specimen figure, which is exhibited in addition to the model. Mr. Thomas Nicholls is the sculptor.

Several fine mortuary monuments are exhibited, which are well worthy of notice. The best of them is the monument to the late Rev. Canon Mill, which is the joint work of Mr. G. G. Scott, R.A., and Mr. J. Philip: it is an alabaster altar, or high tomb, having the sides covered with a diapered pattern, and coloured, a coping of serpentine having a recumbent effigy of the deceased, in canonical vestments, on the top, cast in bronze.

Mr. Forsyth exhibits the full-sized model of a similar high tomb, with recumbent effigy, which has been erected to the memory of the late Earl of Cawdor.

Another tomb of the same class is also exhibited in the sculptor's model. On the top is placed a recumbent figure of a lady, with the feet resting on an Italian greyhound, according to ancient precedent. The sides are partially diapered, enclosing small square panels of sculpture representing the ages of man. Mr. Burges is the architect, and Mr. Nicholls the sculptor of this work.

Another class of tomb is represented by the model, exhibited by Mr. Beresford Hope, of the monument erected to the late Marshal and Lady Beresford from the designs of the late Mr. R. C. Carpenter. In this case there are no effigies: the two low altar tombs, covered by slabs of black marble, are placed under a square canopy showing an arcade of three bays on each face and supported by sixteen slender marble pillars.

A small model by Mr. R. Brandon represents a new style of forming the clerestory windows in churches with timber roofs, by which a large amount of light is admitted through a kind of continuous window, the only breaks being those caused by the thickness of the timber forming the roof trusses. It is more particularly intended for lighting churches which are enclosed by other buildings. An example of its application may be seen in the chapel of The Holy Trinity, Knightsbridge.

A very fine eagle desk is exhibited by the Rev. R. S. Baker, who is also the designer and sculptor. The bird, which is a little larger than life, and is vigorously carved in a natural manner, stands on an eight-sided columnar pedestal. The whole has been cut from a single block of wood, weighing 1½ tons in the rough state.

Mr. John Wilkie exhibits an elaborate piece of wood carving suitable for the central part of a small altar; it is a small work and very highly finished.

Two organs, exhibited by Messrs. Gray and Davison, are similarly decorated, having the pipes illuminated in coloured patterns, and the lower part of the case painted with groups of figures by Mr. C. Blackmore. The subjects represented are, "The Nativity" on one, and "The Song of Miriam" on the other.

Various specimens of domestic furniture are exhibited by Mr. Thomas Seddon, which have been executed from the designs of Messrs. Prichard and Seddon; among them are chairs with the cushions of the seats ornamented with stamped, and gilded, and embroidered patterns. A sideboard by the same exhibitor is executed in a plain manner after a very early Gothic model, and has the lower panels covered with paintings illustrative of the ornamental arts, as illustrated by King René and his queen. An upper series of panels bears allegorical representations of various manufactures.

Several articles of furniture painted and illuminated in a similar manner, are designed by Mr. W. Burges; they are, a buffet with allegorical representations of the metals; a bookcase covered with illustrations of Christian and Pagan art, and a smaller series, in which the "Fables of Æsop," the "Legend of Cock Robin," and similar subjects are represented; a sideboard with the legend of "Saint Bacchus," an escritoire, illustrated with scenes from the story of "Cadmus," and a buffet with the legend of "The Battle of the Wines and Beers," which is supposed to have occurred at the time of the negotiation of the the treaty of commerce with France.

Messrs. Morris, Marshall and Co. exhibit furniture, which is of a still earlier character than that last noticed, including a sofa made of a simple combination of rectangular bars, with loose cushions, and two cabinets, one of which is painted with subjects from the "Life of St. George," and the other with two figures playing at draughts.

Among the specimens of mural decoration are one of "Simeon leaving the Temple," painted on common wall plaster by Mr. T. G. Parry, and one of a series of paintings illustrating the "Life of St. Alban," which will be placed in the chancel of a church now building in the north of England.

Messrs. Clayton and Bell exhibit one of the large medallions incised in stone, illustrating the life of St. Chad, which have been executed by them for the pavement of Lichfield Cathedral.

The floor of the court is furnished with a large number of encaustic tile borders by Mr. Godwin of Lugwardine, Herefordshire.

XXV.—SKINS, FUR, FEATHERS, AND HAIR.

Number of Exhibitors, 68.

SITUATION OF CLASS.—*On the South-western side of the Eastern Transept, immediately adjoining Class XXVI.*—LEATHER.
(The Plan of this small class is unnecessary.)

FURS.

Exhibitors.—Bevington and Morris (4499), R. Drake (4501), T. and C. Ince (4503), R. Jeffs (4504), W. Lillicrapp (4505), S. M. Meyer (4506), G. Poland and Son (4507), E. B. Roberts (4508), G. Smith and Sons (4510), E. T. Nicholay (4512), F. Essex (4550), A. H. Seuger (4509).

The collection of furs is more remarkable for its excellence than for its comprehensive character. All the valuable furs are, however, very well represented. There are white and blue foxes, rare seal-skins, sea otters, Russian, Siberian, and Canadian sables, with minx and ermine of every shade of fineness and colour.

The leading furriers exhibit; but with few exceptions they have limited the furs exhibited to the rarest and most costly descriptions. The seal-skins shown by Mr. Lillicrapp (4505) have never been equalled for beauty and fineness. They are the produce of the small seal, whose habitat is in the waters around Cape Horn and the Falkland Islands.

Mr. Meyer and Mr. Drake also exhibit a great variety of rare furs and skins. Poland and Sons also make a very good display, and Bevingtons send a remarkably fine collection of Angola and other rugs, of every hue and degree of fineness.

The so-called "trophies" in the Nave should be inspected in connection with the exhibition within the Class. Of the furs which are exhibited the following are the most remarkable:—

Among the European furs are the Russian or Siberian sable

(*Martes zibellina*), which is one of the most costly and is manufactured into linings, which are generally used as presents by great potentates, being of the value of 1000 guineas and upwards. The lord mayor, aldermen, and sheriffs, &c., of the city of London, have their robes and gowns furred with this sable according to their respective ranks. The tail of the sable is also used in the manufacture of artists' pencils or brushes. Russia produces about 25,000 of these valuable and esteemed skins annually.

The stone martin (*Martes albogularis*) is widely spread over Europe, and derives its name from the fact of its selecting rocks, ruined castles, &c., as its haunts.

The baum, or wood martin (*Martes abietum*), is so named from its being invariably found in woods and pine forests in Europe. The fur in its natural state is similar to the North American sable, but coarser. It is distinguished by the bright yellow colour of its throat: when dyed, the fur closely resembles the real sable.

The ermine (*Mustela erminea*) is produced in most countries; but the best is from Russia, Sweden, and Norway, and is killed in winter when the fur is pure white (except the tail, with its jet-black tip), it being at that season in its greatest perfection: in summer and spring it is grey, and of little or no value. It is the weasel of more southern climes.

The kolinski or Tartar sable (*Mustela Siberica*) is procured from Russia, belongs to the weasel tribe, and is in colour a bright yellow; it is much used in its natural state, and also dyed to imitate the cheaper sables.

The squirrel abounds in Russia in such immense numbers as would appear almost incredible; the importation from thence to this country alone, last year, exceeding 2,000,000. The celebrated Weisenfels lining is made from the white part of the dark-blue squirrel.

The furs of the black and silver fox are the most valuable of this tribe; they are generally purchased for the Russian and Chinese markets, being highly prized in these countries. The cross and red fox are used by the Chinese, Greeks, Persians, &c., for cloak-linings and for trimming dresses. The white and blue fox is used in this and other countries for ladies' wear.

The otter (*Lutra Canadensis*).—Both North American and European otters are chiefly exported for the use of the Russians, Chinese, Greeks, &c., &c., for caps, collars, trimming national dresses, robes, &c.

The beaver (*Castor Americanus*) in former years was one of the Hudson's Bay Company's most valuable productions; but since its use has been almost entirely discontinued in the manufacture of hats, it has lost much of its value.

The fur of the lynx (*Felie Canadensis*), and lynx cat (*Felis rufa*), when dyed, was formerly much used. It is still dyed and prepared and exported in large numbers for the American market. In its natural state it is a greyish white with dark spots, and is used by the Chinese, Greeks, Persians, and others, for cloaks, linings, facings, &c.

The skins of the wolf (*Canis occidentalis*), the fisher (*Mustela Canadensis*), and the wolverine (*Gulo luscus*), are generally used as cloak and coat linings in Russia. The tail of the fisher is very valuable, and exclusively used by the Jews.

The North American badger (*Taxidea Labradoria*) is also a favourite fur.

The chinchilla (*Chinchilla lanigera*), is exclusively a South American animal, and was introduced into this country and France about fifty years since.

From the tropics, we have the skins of lions (*Felis leo*), of royal tigers (*Felis tigris*), of Cape tigers (*Felis leopardus Africanus*), of the leopard (*Felis leopardus*), and of the panther (*Felis onca*), with many others.

CLASS XXV., SUB-CLASS B.

FEATHERS.

Exhibitors.—**De Costa, Andrade and Co. (4522), Sugden, Son and Nephew (4523), Blyth and Sons (4536), Booth and Fox (4537), Ellington and Ridley (4549), W. and C. Nightingale (4571), Whitfield and Sons (4584).**

All that can be done respecting this collection is to point attention to it. There are but few articles which really require any notice, and these will, to most persons, so nearly explain themselves that the space any description of them would occupy is reserved for more important matters. Two or three things alone it appears necessary to notice.

The grebe (*Podiceps cristata*) is an aquatic bird, inhabiting most of the large lakes in Europe. The choicest specimens are from Geneva, Italy, and Holland. The feathers are of rich white, having the appearance of polished silver, the plumage on the outer edge of the skin being a rich dark brown; it is used by ladies, and forms a most beautiful and aristocratic article of dress; and is worn as trimmings for the trains of court and drawing-room dresses, for muffs, cuffs, boas, &c., &c. It is very durable; the exquisite smoothness of the feathers prevents its soiling with wear.

The bird from which the eider-down is taken is found in large numbers in Iceland, Norway, Sweden, &c., &c. Its colour is dark grey, and its elasticity, lightness, and resistance to wet, are prominent amongst its other advantages; it is used for the inside stuffing of muffs.

The magnificent cases of De Costa, and Sugden, Son and Nephew, are prominent. They are filled with feathers of all descriptions, many of extreme beauty.

SUB-CLASS C.

MANUFACTURES FROM HAIR.

Exhibitors.—J. Aston (4534), A. Barrett (4535), Blyth and Sons (4536), F. Browne (4538), J. Clifft (4541), T. R. Condron (4542), Cooper and Holt (4543), J. Dickinson and Son (4544), The Misses Doherty (4545), T. Doubble (4546), R. Douglas (4547), A. Dow (4548), R. E. Farrant (4551), G. Forster (4552), J. Gosnell and Co. (4553), E. M. Gray (4554), L. Gray (4555), B. Greenwood (4556), A. Herrmann (4558), A. H. Hewlett (4559), W. Hopekirk (4560), R. Hovenden and Sons (4561), W. Howard (4562), J. Jeffcoat (4563), G. King and Son (4564), Loyer and Son (4566), J. Marsh (4567), T. Mason (4568), J. K. Metherell (4569), T. Nash, jun. (4570), W. Nightingale (4571), A. Pemberton (4573), A. Smith (4575), R. Taylor (4576), H. P. Truefitt (4577), W. Truefitt (4578), Unwin and Albert (4579), S. Vickers (4580), T. Wall (4581), C. A. Watkins (4582), E. Webb, (4583), J. Williams (4585), W. Winter (4586), C. Wyatt (4587).

SUNDRIES.

Exhibitors.—C. and J. Clark (4500), J. T. Holden (4502), Tussaud Brothers (4511), H. R. Carles (4539), W. H. Child (4540), S. Hastings (4557), H. Kolle and Son (4565).

In this Sub-Class of the fur section some very important articles are shown. Among others is a case exhibited by the Misses Doherty (4545), of horse-hair ornaments, dyed in various colours, made by peasant girls in Sligo. The effect is very similar to coral, and decidedly pretty.

In manufactures of utility from hair, Mr. Webb, of Worcester, has a good display of the following articles:—Coloured damask hair-cloth and black hair-seating, real crinolines, or fine hair-cloth for petticoats, fine hair-cloth for covering upholsterers' buttons, rough cloth for cider presses and hop kilns, curled hair for stuffing mattresses, sofas, chairs, &c. The coloured hair-cloth is used by upholsterers as a covering for chairs, sofas, &c.; also for the fitting up of steamers, more especially those going to and from India and other hot climates, for which purpose the coolness of the material and its indestructibility by moth and other insects render it peculiarly suitable.

Human hair, raw and manufactured, is tolerably well exhibited. Wigs, partings, and scalps are many, and no doubt excellent: but explanations are unnecessary. The wearers of these often useful manufactures will best judge of them by inspection.

The patent painting-brushes, exhibited by C. A. Watkins, are of peculiar construction, the bristles being fastened to the handle by a metal binding made by winding wire on a mould, and afterwards coating it by dipping it in melted metal, which joins or solders the coils of wire together, forming a solid band, apparently without a joint, having the fibre of the metal in one direction, and thus producing great strength with very little material.

There are also a variety of graining tools, each tool possessing some peculiarity to meet the requirements of the grainer in imitating the various woods and marbles used in decorations.

Shaving-brushes of badgers' hair, in ivory handles, are examples of fine workmanship and materials.

Mr. Howard shows the application of gutta-percha for securing brush hairs. There are several other exhibitors whose manufactures show much ingenuity.

CLASS XXVI.—LEATHER, INCLUDING SADDLERY AND HARNESS.

Number of Exhibitors, 136.

SITUATION OF CLASS.—*Immediately adjoining Class XXV., and extending westward from the Eastern Transept to Iron and Hardware.*

This Class is divided into three Sub-Classes, LEATHER, SADDLERY and HARNESS, and MANUFACTURES GENERALLY MADE OF LEATHER.

For the names of the exhibitors, the reader is referred to the Catalogue, since it is not easy to break this Class up into groups without many repetitions of the same name. In considering this Class the case in the Nave, of Bevington and Sons, must not be forgotten.

In addition to the leathers in ordinary use, Messrs. Hepburn and Sons (4636) exhibit specimens of walrus, hippopotamus, and elephant hide. Leather bands for machinery, hydraulic leather, and hose-pipe, fire-buckets, &c., are exhibited by the same firm, by Morris and Co. (4653), and by others. Messrs. D. and E. Roberts (4657) also exhibit some very beautiful morocco leathers of every shade and colour; and Messrs. Wilson, Walker and Co., of Leeds (4667), have a very extensive and handsome display of fancy sheep-leather, coloured calf, &c.

The process of leather manufacture is well shown by the photographs and examples in Messrs. Bevington's case.

The hides are brought to the tanner either in a fresh state, when from animals recently slaughtered, or, when imported from other countries, dried or salted, and sometimes both, for the sake of preserving them from decomposition. In the former case the horns are removed, and the hide is scraped to cleanse it from any portion of flesh or fatty matter; but in the latter it is necessary to soften the hides, and bring them as nearly as possible to the fresh state, by steeping them in water and repeated rubbing or beating. After this the hair is removed—sometimes by steeping the hides in a solution of lime in water for several days, and sometimes by suspending them in a *smoke-house*. The hair is carefully removed by a curved knife, and the hides are prepared for the actual tanning by steeping them for a few days in a pit containing a solution of rye or barley flour, or in a very weak menstruum consisting of one part of sulphuric acid mixed with from 500 to 1000 parts of water. The hides or skins are then placed in the tanning solution, which is generally an infusion of oak bark, or some other vegetable product rich in tannic acid. Besides oak bark, which is employed in the greatest quantity, valonia—the acorns of the *Quercus ægilops*—is brought from the Levant and the Morea. Catechu, or *Terra japonica*, the inspissated juice of the *Acacia catechu*, and a bean-pod called the *divi-divi*.

Tawing is the name applied to the process by which the skins of sheep, lambs, and kids are converted into soft leather by the action of alum: of this leather gloves are usually made.

Currying is the process of dressing the leather so as to fit it for the purposes of manufacture. Many parts of the process are of exceeding delicacy, requiring much manipulatory skill.

The Sub-Class B. includes every variety of saddles, harness, whips, saddlers' ironmongery, safety collars, and collars for preventing crib biting. The collection of Messrs. Gibson (4705), Merry (4731), Wilkinson and Kidd (4753), Gordon (4706), and Middlemore (4730), are the principal among the saddlery and harness exhibitors; and Mr. Martin (4729), and Messrs. Swaine and Adeney (4746), among the whip-makers. The contributions of the two last-named firms are exceedingly handsome.

The saddlery and harness of Mr. W. Lennan is of the highest character; and the harness of Messrs. Oldfield will commend itself to all who can appreciate superior workmanship. Whippy, Steggall and Co. exhibit some harness and saddles which will bear comparison with any other; while the saddlery for exportation, made and exhibited by E. Banton and by W. Middlemore, will maintain the high character which the English manufactures of this class have always held. The anti-crib-biter of Joseph Lea is well contrived: its chief recommendation is, it does not punish the horse as most other inventions do, but has simply to be placed on the horse's head, the same as an ordinary collar, and the horse is at once prevented from crib-biting, at the same time he can take his food, and drink, without any removal.

The military officers' accoutrements, exhibited by J. and R. Earratt, by H. Maxwell and Co., are very fine examples of this class of manufacture.

CLASS XIII.—PHILOSOPHICAL INSTRUMENTS, AND PROCESSES DEPENDING UPON THEIR USE.

Number of Exhibitors, 163.

SITUATION OF CLASS.—*This important and interesting Class is in the Gallery of the North Court.*

PHILOSOPHICAL AND MATHEMATICAL INSTRUMENTS.

Exhibitors.—**P. Adie (2846), British Association (2865), E. Burton (2869), T. E. Butters (2871), L. P. Casella (2874), J. M. and H. Cronmire (2885), J. P. Cutts, Sutton, and Son (2887), Elliott Bros. (2897), G. Knight and Sons (2923), Murray and Heath (2937), Newton and Co. (2940), J. Orchard (2942), J. Parkes and Son (2943), F. Pastorelli and Co. (2944), F. W. Stanley (2968), B. Stewart (2970), J. Warner (2985), E. G. Wood (2994), Yeates and Son (2996).**

Messrs. Elliott Brothers exhibit a number of electrometers of the most delicate kind; large electrifying machines with ebonite discs; improved air-pumps on a large scale; and a beautiful collection of drawing instruments.

Messrs. Murray and Heath show an improvement upon the electric lamp, by which the electrodes are kept at constant distances without the intervention of any clock-work motion. It is not easy, in the absence of a drawing, to describe this piece of apparatus, in which all the arrangements are exceedingly well conceived. The advantages are, that the light is constant, the movement simple, and the lamp can be used with any battery, the adjustment by means of the distance of the magnet and keepers, and the amount of the current sent round it, by means of the Rheostat, giving perfect control over the movement.

Mr. P. Adie (2846) exhibits his semicircle sextant, embracing a new system of reflection by which the absolute degrees of the angle on the limb can be read off, and possesses the advantage of being one half the size of a Hadley sextant of equal power, while as it reads to 180° it has one-third more compass. Mr. Adie also exhibits a telemeter for measuring distances. This instrument consists of two telescopes brought to bear on the same object from either extremity of a given base.

Mr. Babbage's calculating· machine, or, more properly speaking, engine, for such he calls it, is exhibited in this Class by Government, to whom it belongs. The idea of a calculating machine is not new. The celebrated Pascal constructed a machine for executing the ordinary operations of arithmetic, and Leibnitz invented another by which arithmetical computations could be made. Subsequently, Palenus, a learned and ingenious Italian, constructed a machine capable of performing many arithmetical processes. These engines, however, which were of the most elementary kind, were merely modifications of Pascal's, and very different from Mr. Babbage's difference engine. This gentleman having made a model of the proposed engine in 1822, the Government requested the Royal Society to examine it and report "on the merits and utility of the invention," and the report being favourable, the Treasury placed £1500 at Mr. Babbage's disposal to "bring his invention to perfection."

This was the commencement of an undertaking which extended over many years, and involved an amount of labour and anxiety which has rarely been surpassed by any philosopher; and it is right to state that Mr. Babbage gave his mental labour gratuitously, and that from first to last he has not derived any emolument whatever from Government—all the money granted by Parliament having been expended on the construction of the engine. It would be quite impossible, within the narrow limits of this publication, to give anything like a comprehensive history of this undertaking which extended over a period of twenty years.* Briefly, then, it may be stated, that as time went on Mr. Babbage's inventive genius conceived various improvements in the engine, until finally a principle of an entirely new kind occurred to him, the power of which over the most complicated arithmetical operations seemed almost unbounded. These new views acquired additional importance from their bearings upon the engine already partly executed for the Government, upon which £17,000 have been expended. But although Mr. Babbage now felt confident that he could carry out his invention, all the greatest mental difficulties having been surmounted, Government declined advancing more money, and the work was stopped. This determination was communicated to Mr. Babbage in a letter from Mr. Goulbourn, dated November 3, 1842, containing the following passage:—

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* A full account of the engine will be found in Mr. Weld's "History of the Royal Society," compiled from documents placed in his hands by Mr. Babbage.

"Sir R. Peel and myself regret the necessity of abandoning the completion of a machine on which so much scientific ingenuity and labour have been bestowed. But, on the other hand, the expense which would be necessary in order to render it either satisfactory to yourself, or generally useful, appears on the lowest calculation so far to exceed what we should be justified in incurring, that we consider ourselves as having no other alternative."

The engine which Mr. Babbage wished to construct was intended to either tabulate, or develop, or to weave, as it were, algebraical patterns, just as the jacquard loom weaves figures of flowers and leaves. The present engine is capable of calculating to five figures, and two orders of differences, and performs the work with absolute precision; this being one of the great advantages of a mechanical calculating engine, for when it fails to calculate correctly some portion of the machinery has broken, and it stops working; but no part whatever of the printing machinery, which was one of the great objects in the construction of the machine, has been connected with the calculating portion.

Although Mr. Babbage's mechanical work was arrested for want of funds, his head went on constructing, and he has laid down on paper all the sections of his proposed analytical engine, which cover about five hundred large folio sheets.

It is not a little remarkable, however, that just at the period when Government declined to assist Mr. Babbage further, two Swedish gentlemen, the Messrs. Scheutz of Stockholm, having read an account of Mr. Babbage's difference engine, set to work, and after much labour and an expenditure of money, which to them was ruinous—as the Swedish Government declined to reimburse them—constructed an engine, which not only calculates, but also prints the calculations. One of these machines is now at the Registrar-General's office in Somerset House, where it is used for calculating and making the types for various tables required in the above office, such as the logarithms of the value of human life, male and female, in the metropolis and other parts of England; the value of a given annuity for any number of years, &c.

Professor W. Thomson, F.R.S., exhibits his portable apparatus for observing atmospheric electricity. This consists of—1. Portable atmospheric electrometer with burning match collector. 2. Water-dropping stationary collector of atmospheric electricity, for travellers.

In the portable electrometer a light nubble of aluminium is attached to a fine platinum wire stretched tightly in a line through its centre of gravity; one end of this wire is carried round through any required angle, measured by means of a divided circle, on Coulomb's torsion principle. The needle, wire, and circle are all insulated in the interior of a Leyden phial, which is kept constantly charged with negative electricity. Two metal plates in metallic communication with the needle repel its ends with force, depending on the difference of potential between them and the inner coating of the phial, and measured by the amount of torsion required to bring the needle to a sighted position. An insulated metal stand, connected with the repelling plates and needle, bears a burning match at a height of about three feet above the instrument, which is held by the observer in his hands, with the aid of a shoulder-strap. The needle, repelling plates, &c., are thus, by the burning match brought to the same electric potential as the air at the place of the fire. This is generally, in fair weather, positive, the earth's potential being regarded as zero. It therefore differs more from the potential of the inner coating of the Leyden phial than does the earth's potential; the result being demonstrated by the greater amount of torsion required to bring the needle to its sighted position, when the match is burning and its stand insulated, than when the stand is put in connection with the earth. During rain, or in broken weather, the air potential is often negative, and then a smaller amount of torsion is necessary when the match is burning and the stand insulated, than when the earth connection is made. The differences of the square roots of the amounts of torsion in ten different cases measure accurately the differences of the potentials measured.

The air within the electrometer is artificially dried by pumice-stone, moistened with sulphuric acid in proper receptacles. Thus, in the moistest weather, even during heavy rain, the insulation of the inner coating of the Leyden phial, and of the needle, the repelling plates, &c., is very perfect.

In even a very damp climate it is not necessary to charge the Leyden phial more than three or four times a year; although it may be useful to replenish it every four weeks, so as to keep its charge always at the most convenient degree for the particular use that is made of the instrument.

The water-dropping collector is a metal can on an insulated stand, placed generally indoors, inside a window. A metal pipe, connected with the can, passes through an aperture, to the distance of three or four feet outside the house. Water flows from the can, and thus reduces the whole metal connected with it to the same potential as that of the air at the point where the stream from the nozzle breaks into drops. The atmospheric electricity thus obtained may be measured by means of the portable electrometer, or any other convenient electrometer for indoors use. This form of collector is more convenient than the burning match for observing at any fixed station, whether within doors or not.

The can and its insulating stand, with hot-water apparatus, or sulphuric acid chamber, for drying the glass stem which supports it, are arranged to be portable and to carry the sulphuric acid receptacles, and various minor appurtenances of the electrometer.

The specimens of manufacture exhibited by Messrs. Horn and Thornthwaite are intended as illustrations of the chief classes of scientific instruments which are manufactured under their own inspection, by their own workmen. Among the most important of these is an achromatic microscope and apparatus with Horn and Thornthwaite's aplanatic eye-pieces, tilting movement to the stage for viewing sides of cavities, and a selenite stage. An apparatus for exhibiting the chief properties of polarized light, including an application of the kaleidoscope and binocular arrangement. Apparatus for spectrum analysis, with universal stand and micrometer eye-piece; a new equatorial star-finder; "the alpine or mountain barometer," constructed on the same principle as the aneroid; but in addition to the usual scale of inches and tenths, it has an inner set of divisions termed the altitude scale. This instrument possesses the great advantage of enabling tourists and alpine travellers to ascertain at a glance the altitude above their starting point, at any moment, and the results obtained will be sufficiently accurate for all ordinary purposes. It is made in two sizes, the largest the same size as an ordinary aneroid barometer, and the smaller is only 2¾ inches in diameter, and weighs under twelve ounces.

Mr. C. Moore exhibits a most useful instrument called the "Great Circle Indicator," which greatly facilitates the theory of navigation. Its great simplicity renders its working and importance apparent to all persons of common understanding; and so effective is it, that the navigator may ascertain by its use his exact latitude, the true magnetic courses, the deviations of the compass, by local or other attractions, as also the nearest arcal distance between any port or place of observation, and other ports or places of observation. Its importance is not confined to nautical men, but it is also highly useful in mathematical schools, as by it the spherical calculations are illustrated so distinctly as to give a perfect facility for progressing in this science to persons of even the meanest capacity. See vol i., p. 370.

Mr. Warren De la Rue (2893) exhibits, as objects of scientific interest, a series of photographs on glass of the several phases of the total eclipse, observed at Riva Bellosa, in Spain, on July 18, 1862.

In these pictures of the eclipse, the sun is seen erect, that is, as he would be observed in an ordinary non-inverting telescope. The apparent motion of the moon is therefore from the right towards the left. The undulating edge of the moon is distinctly traceable in the several phases of the eclipse, and in some she is just occulting, and in others just sliding off one or other of the three conspicuous sun spots visible on that occasion. The most interesting of the pictures are those taken during the totality, which are placed in the centre of the group: on these will be seen the remarkable luminous prominences which surround the sun's disc not ordinarily visible, but which are only to be observed on the occasion of a total eclipse, because our atmosphere in apparent contiguity with the sun, is so much illuminated, as to neutralize the less brilliant light of the prominences, which are about 600 times less brilliant than the sun's disc. Some of these prominences are of remarkable dimensions; the highest was calculated to extend 72,000 miles beyond the sun's limit; another, called the floating cloud, was 14,000 miles distant from it. There is little doubt but these prominences are vaporiform clouds, illuminated by the incandescent disc of the sun.

Mr. De la Rue also exhibits some remarkably beautiful photographs of the moon, eight inches in diameter, which represent the moon, not as in nature, but reversed, that is, as she would be seen in an astronomical inverting telescope. These 8-inch pictures are enlarged copies from the original negatives, made by means of an enlarging camera. The original negatives are about one inch in diameter, and are obtained by means of a reflecting telescope, of 13 inches aperture, and 10 feet focal length, mounted on what is called an equatorial stand, and moved by means of clock-work to follow the moon so precisely that she appears absolutely at rest on the sensitive plate. The difficulties in making these photographs are very great, and require a combination of chemical and mechanical skill to master. The conspicuous crater, like the pip in an orange, is called Tycho; another, in the lower half of the moon, Copernicus, from which starts a remarkable curved ridge of hills called the Apennine ridge.

In the lower part of the Case are the phases of a lunar eclipse: it is worthy of notice that the boundary of the eclipsed portion of the moon is not marked with that precision which obtains in a solar eclipse, because of the shadow of the earth diffused by our atmosphere.

The *Spirameter*, by Edward Smith, M.D., F.R.S., is an application of the principle of the dry gas-meter, to measure the air in inspiration. *Novelties.*—The inversion of the action, so that it moves by suction; the measurement of the inspiration, with the registration from 1 to 1,000,000 cubic inches; the enlargement of the areas of the apertures, so as to reduce the adverse pressure. The addition of a mask to enclose nose, mouth, and chin with valvular apertures, and straps to fasten it upon the head, so that it may be worn, and the air measured during sleep and for any length of time.

Gutta-percha Potash Box.—This is so divided into chambers and compartments, that a current of air 2 inches × $\frac{5}{8}$ inch must traverse the whole surface of 700 superficial inches, and then permit the carbonic acid from the inspired air to be absorbed during the act of expiration. A solution of potash is placed in each chamber, and may be introduced and emitted by separate tubes leading to each chamber, or by openings in two tubes placed within each other, so that the inner one, by being turned half round upon its axis, may close the openings. *Novelties.*—The use of the material; the capacity to absorb the whole carbonic acid during the act of expiration, and for any period; the arrangement for charging and discharging the absorbent; the capability of determining the weight of the gas absorbed by weighing, to the one-tenth of a grain, and the permitting experiments to be made during sleep and exertion for considerable periods.

The instruments exhibited from the Kew Observatory are described separately.

ELECTRO-TELEGRAPHIC APPARATUS AND APPLIANCES.

Exhibitors.—T. Allan (2850), J. W. Brett (2863), British and Irish Magnetic Telegraph Co. (2864), G. Clark (2878), Glass, Elliott and Co. (2900), W. Hooper (2915), Reid Bros. (2949), J. Rogers (2950), E. B. Sharp (2956), Siemens, Halske, and Co. (2959), Submarine Electric Telegraph Co. (2971), E. Tyer (2977), Universal Private Telegraph Co. (2978), C. F. Varley (2981), C. V. Walker (2983), Wells and Hall (2988), H. Wilde (2992), C. S. Duncan (2896).

The Universal Private Telegraph Company exhibit a set of Professor Wheatstone's Magneto-Electric Telegraph instruments. Previous to Mr. Wheatstone's invention of letter-showing telegraphs; the only mode of signalling was by means of arbitrary signs, requiring special training on the part of the operators: by the present alphabetical telegraph messages may be sent by any person, the letters composing each word being successively signalled by the person sending the message. No battery is required for this instrument, it being worked by a magnet. This telegraph is now extensively used by Government offices and mercantile firms in London and Glasgow, Manchester and other parts of the kingdom. This company also exhibit Professor Wheatstone's Automatic Printing Telegraph, which will transmit five hundred letters per minute without any liability of error; an electric clock, with several small clocks in connexion; alarm and exploding bells worked by electricity; and an ingenious magnetic register, showing the number of persons passing through doorways, turnstiles, &c.

The British and Irish Magnetic Telegraph Company exhibit an ingenious and novel system of controlling turret, and other clocks, patented by Mr. L. Jones of Chester, unlike any previously in use, the clocks being controlled only, and not moved either in whole or part, by electricity. The three clocks shown in the class are in all respects, excepting the pendulum, of ordinary construction, and will go without the electric current, keeping their own time. The pendulum is a hollow electric magnet, oscillating over or around permanent magnets. When a current is sent, second by second, from a controlling clock, the temporary attraction between the electric magnet and the permanent magnet compels the controlled pendulum to copy the vibrations of the controller, even though there may be a discrepancy of several minutes in their daily independent rates.

The above company also send the acoustic telegraph, a very ingenious instrument extensively used, invented by Sir Charles and Mr. E. Bright. By its means a telegraph clerk in taking off a message writes it himself, without being obliged to raise his eyes from the paper, the signals being produced by strokes on a pair of bells of different tones, one placed on either side of his writing-desk. It is well known that practice makes the ear extremely sensitive to sound, and even in the ordinary telegraph, the intensity of the click of its needles is measured with very great nicety by long practised telegraph clerks.

Mr. C. V. Walker, the telegraph engineer of the South Eastern Railway, exhibits the apparatus in use throughout the lines of the company for train signalling. The most important feature in this valuable apparatus is its extreme simplicity, being almost destitute of mechanism, in order to lessen the chance of its getting out of repair. Mr. Walker also exhibits a graphite battery, in work, remarkable for its simplicity of action, and the constancy of power evoked; an audible system of train-signals, and an apparatus for recording them.

Messrs. Glass, Elliott and Co. exhibit a very interesting series of submarine telegraph cables, all specimens shown being sections of cables actually at work, comprising a total distance of 3940 miles, and made up as follows.

	Miles.
Denmark to Sweden	12
Italy and Corsica	110
Corsica and Sardinia	10
Egypt	10
Newfoundland to Cape Breton	85
Mouths of the Danube	3
Prince Edward's Island to New Brunswick	10
Norway, across fiords	49
Mainland of India	30
England to Holland	140
England to Hanover	280
Norway, across fiords	16
Alexandria	2
England to Denmark	368
Sweden to Gothland	64
Folkestone to Boulogne	24
Liverpool to Holyhead	25
Rivers in India	10
Malta and Sicily	60
England and Isle of Man	36
Jersey to Piron on Coast of Normandy	21
France and Algiers	520
Toulon and Corsica	90
Corfu and Otranto	195
Malta and Alexandria	1535
England to Holland	135

Mr. W. Hooper exhibits some sections of submarine telegraph cables, which are designed to show the advantages of india-rubber as an insulator of the highest order, and vulcanate or vulcanized india-rubber as a protector.

Although india-rubber was employed as early as 1841, as an insulator, still it has never been generally adopted, owing to its not having been reduced into one homogeneous mass, and also in consequence of its becoming oxidized, and ultimately dropping from the conductor.

The result of a long series of investigations give proof that by preventing the india-rubber from being injured in the course of preparation, and enclosing it within a coating of vulcanite, or vulcanized india-rubber, the india-rubber consolidates round the conductor, whilst under the heat necessary to vulcanize the "protector." This prevents the oxygen of the air, sea-water, or the temperature of any climate from changing the first or inner coating. The consolidation of the india-rubber takes place from absolute necessity, as its fusing point is 248° Fahrenheit, whilst the vulcanized point is 280° Fahrenheit.

Vulcanized india-rubber has long been used for marine work, and its durability fully established, whilst it is found, under a pressure of 25,000 lbs. to the square inch, to be less porous than any other dielectric employed in coating submarine telegraph wires.

James White, Glasgow, exhibits a marine galvanometer, Thomson's patent, 1858—a portable instrument, especially adapted for use at sea. Inside the galvanometer coils, a small magnet and mirror are strung on unspun silk fibre, passing through their centre of gravity. Outside the coils a strong directing magnet overpowers the directing force of the earth's magnetism. By this arrangement neither the course nor the motion of the ship sensibly affect the position of the suspended magnet relatively to the coils. The deflections caused by currents through the coils are shown by a spot of light reflected on to a scale. The spot of light remains quite steady, no matter how much the ship pitches or rolls. Most accurate measurements of electric currents can thus be made at sea in all weathers. The static reaction governor exhibited is Thomson and Fleming Jenkins' patent. It is a centrifugal governor, in which the static reaction, resisting the centrifugal force developed in the revolving mass, is employed to apply a break to the revolving shaft, of which the motion is to be controlled, whilst at the same time this application of the reaction does not affect the divergence of the revolving mass from the axial shaft. Moreover, the increment of the force restraining the divergence of the revolving mass is so adjusted to the increment of centrifugal force consequent on the divergence, that the centrifugal force is equally, or very nearly equally, balanced at the one speed, whatever be the divergence of the revolving mass. The force restraining the divergence in the instrument exhibited, is obtained from an adjustable spring. This governor is useful wherever uniform motion is required, under various conditions of driving and resisting forces, and is especially adapted for telegraphic transmitting and receiving apparatus.

They also exhibit a tangent galvanometer, on Dr. Joule's plan, with modifications, to render it portable. The peculiarity of Joule's tangent galvanometer is the smallness of the needle, which is from ¼ to ½ inch long. It carries an exceedingly light glass bar as index of its angular motions. The whole moving mass is so light that a single silk fibre is quite sufficient to bear it; and its indications are very rapid and accurate. The shortness of the needle allows a coil of very small diameter to be used without losing accuracy. In the instrument exhibited, the inner diameter of the coil is very small. A mechanical appliance has been introduced by the maker, Mr. White, to lift the needle, and hold it securely without danger to either the silk fibre or the glass index. The instrument is thus rendered extremely portable and convenient for practical electricians, especially in telegraphic testing.

Messrs. Wells and Hall exhibit some beautiful specimens of telegraph wires, insulated with caoutchouc; submarine cable, for deep or shallow waters, the former having a specific gravity of 1·35, made with best Russian hemp (braided in a peculiar manner by their patented process), in combination with steel wires; thereby preventing twisting, kinking, or any perceptible elongation when strained to, and having a tensile strength equivalent to 11,635 fathoms in sea water.

Messrs. Siemens, Halske, and Co., are exhibitors of ink-recording apparatus, for submarine and other lines; also their recording apparatus with Morse instruments, for the transmission of messages in opposite directions at the same time. This is combined with alarums for different purposes, such as calling officers to attend to the instruments, and for giving calls and signals to officers of fire brigades, police stations, &c., and with the magneto-electric dial instruments for railway, military, and private telegraphs; railway alarum, worked by a powerful magneto-induction battery, to signal the departure and arrival of trains along the line, &c., &c.

There is novelty in the idea of C. S. Duncan's Matan deep-sea electric telegraph cable.

The Matan cane is adopted as an external protection to the insulating medium; from its peculiar imperishability and strength, as a substitute for steel or iron wire, and hemp, neither of which can be preserved against oxidation, or the attacks of the ocean animalculæ; and all insulating materials now used are too tender to be exposed as an outer covering under any form or combination.

The cane possesses great flexibility, strength, durability, and economy in the manufacture: it has been employed by the Chinese for centuries past for holding fast their junks and anchors. Sheltered with a silicated rind, and possessing neither resinous, oleaginous, nor saccharine matter, no chemical change is effected by submersion. It can be adapted for protecting aërial and subterranean electric wires.

MICROSCOPES AND MICROSCOPIC PREPARATIONS.

Exhibitors.—**W. L. Aldous (2848), C. Baker (2853), Prof. Beale (2855), J. Casartelli (2873), J. H. Dallmeyer (2888), J. B. Dancer (2889), A. Hett (2910), Horne and Thornthwaite (2916), W. Ladd (2925), J. Norman (2941), J. Parkes and Son (2943), F. Pastorelli and Co. (2944), Powell and Lealand (2946), Rev. J. B. Reade (2948), W. J. Salmon (2953), W. E. Scott, (2955), H. Sharp (2957), C. M. Topping (2975), C. Varley (2960), H. Webb (2987), F. H. Wenham (2989), J. Swift (2974), S. Highley (2912), J. Barnett (2854).**

The collection of improved binocular microscopes is the finest that has ever been brought together. Certainly, within a few years the improvements which have been made—especially in the mechanical arrangements of microscopes—have been very great.

Messrs. Smith and Beck are exhibitors of the following novelties:—

A large best portable microscope, with the stage made to remove and the legs to fold up, so that, together with the most complete apparatus, it will pack in a comparatively small case.

The binocular body, as contrived by Mr. Wenham, is by far the most important improvement of late in the achromatic microscope. This arrangement is applied to nearly all the instruments they exhibit; and in the manufacture they have a means of working the prisms which insures great accuracy, and preserves the definition of the object-glass to the greatest extent possible. Mr. Wenham is also himself an exhibitor.

Amongst the apparatus is a new quadruple nose-piece; large Nicol's prism as a polarizer; and an instrument for the examination of opaque objects.

The object glasses of the microscopes generally, although of no new construction in particular, have yet the following advantages. In all of them the aberrations are corrected as entirely as possible, and in none is the aperture larger than is consistent with this result: these qualities, together with the workmanship, may be tried by the most severe tests, and more especially by those which are illuminated from above, or, as they are generally termed, opaque objects.

The aperture of the lower powers has been considerably enlarged; and they also show a series with moderate apertures and of low price.

The universal microscope is the last form of cheap instrument, completed by these exhibitors.

For five guineas they supply a stand, with quick and slow motions; the stage has a moveable object-holder, and a diaphragm underneath, complete movements to the mirror, two eye-pieces, 1-in. and ¼-in. object glasses, a few small accessories, and a case.

But the most important feature connected with the universal microscope is its capability of receiving valuable additions, at a moderate price, without the necessity of its being returned to the makers.

Messrs. Smith and Beck also exhibit a "Museum Microscope" of new construction. It has 504 objects so attached to it as that any of them can be seen under three magnifying powers. The necessary adjustments are complete in every respect; and directions for its use and a catalogue of the objects accompany·the instrument.

Mr. Baker exhibits a fine collection of binocular and other microscopes.

Mr. P. H. Desvignes has an instrument, called by him a mimoscope, to exhibit drawings, models, figures, single or stereoscopic photographs, so as to imitate animal movements, or that of machinery, showing various other illusions.

Pillischer exhibits a new form of microscope which has a moveable stage of extreme simplicity, and an objective of an entire new combination, forming three distinct sets of powers of excellent quality. This microscope is intended to supply the want of a really good, and at the same time, cheap instrument.

Mr. Peters, of the banking firm of Masterman, Peters and Co., exhibits a most ingenious machine for microscopic writing, combining Ibbetson's geometric chuck. This is an invention of great merit. With the machine, which is simple in appearance, an almost endless diversity of beautiful and complex curves, including any combination of bicircloids, can be produced with wonderful precision and minuteness, within a circle the fiftieth of an inch in diameter.

A disc, the one-hundredth of an inch in diameter, appears to the unaided eye as a mere point, yet that point may be made to contain five circles of the three-hundredth of an inch in diameter, and in one of those circles, about the size of a tranverse section of the human hair, the Lord's Prayer can be written and read. It has been legibly written also in the three hundred and fifty-six-thousandth part of an inch. The words, "Matthew Marshall, Bank of England," have been written in the two-and-a-half millionth part of an inch; and a calculation has been made, that with this machine the entire Bible might be written several times in the space of a square inch.

Mr. Thomas Ross exhibits a remarkably fine collection of miscroscopes distinguished for the excellence of their mechanical and optical parts. For accuracy of definition and flatness of field, the object glasses have never been excelled, and rarely equalled.

Powell and Leland have an object glass of remarkable power; and S. Highley exhibits students' microscopes of a very excellent character and exceedingly cheap.

Rev. J. B. Reade, F.R.S., Ellesborough Rectory, is an exhibitor of his hemispherical condenser for microscopes, illustrating a new principle in microscopic illumination.

The condenser consists of a hemisphere of glass, about one and three-quarter inches in diameter, with a new arrangement of stops, *applicable to all condensers*, for regulating the number, position, and magnitude of transmitted pencils of oblique light. The control thus obtained over the illumination of test objects not only enables the single lens to compete with expensive achromatic condensers, but it also, for the first time, brings difficult test objects under the command of half-inch object-glasses, and thus tends to advance microscopic investigation by saving the cost of hitherto necessary apparatus. Two similarly-pierced diaphragms, shown half-size in the engraving in the "Illustrated Catalogue," give one, two, or three apertures for transmitted light, with distances between them varying from 30° to 120°.

In the application of this condenser to the resolution of lined test objects, the principle sought to be carried out is to throw the axis of the illuminating pencil in a direction at right angles to the line to be resolved. This is effected by the rotation of the sub-stage, while the lines of markings on the object under examination determine the number of apertures to be used. Under this new arrangement of small illuminating pencils, that portion of the light of the ordinary spot lens, which really tends to obliterate the shadows by throwing them in directions opposite to each other, is stopped out; the markings, whether elevations or depressions, are illuminated on the same side, and we preserve that uniform direction of the shadows which is the key to accurate definition.

THERMOMETERS AND BAROMETERS.

***Exhibitors.*—J. Bligh (2860), P. Cameron (2872), T. Chatterton (2877), J. E. Coombs (2881), W. Hinton (2913), H. Johnson (2920), J. Orchard (2942), J. B. Ronchetti (2951), W. E. Scott (2955), Spencer, Browing and Co. (2962), J. Walter (2984), F. L. West (2990), E. and J. Davis (2891), F. Mata (2933), L. P. Casella (2874), Negretti and Zambra (2939).**

Mr. Casella (2874) exhibits a series of standard meteorological instruments of most sensitive character. The mercurial minimum thermometer, recently invented by Mr. Casella's son, is well represented and will doubtless much attract the attention of scientific foreigners. Surveyors, naval and military gentlemen, and travellers generally, will find portability a prominent feature in the articles in this Case. It is surmounted by a large Robinson's self-registering anemometer or wind-gauge, the indicating parts of which are so modified as to pass through the top as well as through the roof and floors of a house, admitting of readings being taken in a lower apartment.

Negretti and Zambra show a very large and important collection of meteorological instruments, a great number of which are self-registering. Among these is a thermometer so exquisitely sensitive as to rise at once upon the approach of the hand within two or three inches. This instrument was made specially to test the temperature of the body and coils of the python during her abortive incubation at the Zoological Gardens. The collection of thermometers by this firm is not a little remarkable. Their minimum and maximum instruments are peculiarly ingenious. Their vacuum solar radiation thermometer consists of a blackened-bulb thermometer, enclosed in a glass tube and globe, from which all air is exhausted. Thus protected from the loss of heat which would ensue if the bulb were exposed, its indications are from 20° to 30° higher than when placed side by side with a similar instrument with the bulb exposed to the passing air. It is also found that the readings are almost identical at distances from the earth varying from six inches to eighteen inches. By the use of this improved solar radiator it is hoped that the amounts of solar radiation at different places may be comparable; at present they are not.

Their deep-sea sounding thermometer is a very skilfully-devised instrument. The bulb of the thermometer is enclosed in a second cylinder of strong glass nearly filled with mercury: the space above the mercury being a vacuum, any pressure exerted at great depths takes effect on the outer cylinder, and raises the mercury in vacuum; the internal or thermometer bulb being thus free from error arising from pressure. Their terrestrial radiation thermometer is a very delicate instrument. The bulb of this instrument is transparent, and the divisions engraved on its glass stem, similar to that for solar radiation. In use, to be placed with its bulb fully exposed to the sky, resting on grass, with its stem supported by little forks of wood.

J. Hicks has an excellent minimum mercurial thermometer.

The barometers exhibited by this firm are of the most perfect description. Their standard barometer is a modification of Newman's. There appears to be great convenience in their new form of mountain barometer; reading from a centre, as in the ordinary syphon barometer. This barometer can be rendered portable by turning the ring at bottom, when the tube is full of mercury; it can also be easily cleaned by removing the outer glass cylinder at bottom forming the second reading surface, and as readily put together again. In this barometer the great desideratum of rendering the Gay-Lussac or syphon barometer portable and easily cleaned is achieved.

The electric barometer is highly ingenious. A platina wire is inserted at top of tube, and when contact is made with it, by screwing up the cistern at bottom, the needle is deflected; the connections are then reversed by means of the small brass handle, and the rod carrying the circular plate is screwed down. The instant contact is made, the needle is again deflected in the reverse direction. The length of column is now read off from scale and circular vernier.

The barometrical thermometer, or hypsometrical apparatus, as constructed by Negretti and Zambra, is intended to meet the requirements of travellers in circumstances where the mercurial barometer cannot be conveniently employed. The instrument is very portable, and affords a ready and accurate means of measuring heights by observations of the temperature of boiling water.

The instruments made by this firm, under the directions of Admiral Fitzroy, are well known. The only other instrument of this class requiring any notice is Negretti's dry and wet bulb hygrometer, which is an admirable instrument for determining the dew-point.

The marine barometer, recommended by the Kew Committee of the British Association. In the year 1854 the Kew Committee of the British Association had under consideration the best form of a marine barometer, and having examined several different instruments submitted to their inspection, ultimately selected one made by Mr. Adie, the action of which was tested by Mr. Welsh (accompanied by Mr. Adie) in several coasting voyages. This instrument has since been used very extensively at sea, where it has given great satisfaction. It is thus described by Mr. Adie: "The tube, for about four inches near the middle, has a capillary bore which operates to prevent inconvenient oscillation at sea from the motion of the vessel. A papette is inserted a little below the contraction, which prevents the entrance of air into the upper part of the tube. The cistern is of cast iron, the tube being fitted into it mercury-tight by cement. A portion of the upper part of the cistern is covered with strong sheepskin leather, which is found to be sufficiently porous to admit the free access of air, while, at the same time, it prevents the mercury from escaping. The cistern is filled with mercury to such a height that it can never, under any circumstances of temperature or pressure, be full, while it is always sufficiently so to prevent the lower end of the tube being exposed, either during carriage or when in use. The correction for the relative capacities of the tube and cistern is in this instrument included in the graduation of the scale, the divisions being shortened by the amount of the correction, so as to represent the true measurement." An unmounted tube is also exhibited in order to show the pipette and contraction.

Mr. Pillischer exhibits a new self-registering barometer on a new plan. It has a clock movement, and as the clock strikes the hours a black dot is imprinted on scaled paper.

Chadburn Brothers have some barometers upon Admiral Fitzroy's principle, with metal frame for out-door use, also some with new adjustment tube.

COMPASSES AND SURVEYING INSTRUMENTS.

Exhibitors.—**P. Adie (2846), R. Adie (2847), J. W. Bailey (2852), P. Cameron (2872), Dent and Co. (2894), S. Green and Son (2903), T. Herbert (2909), V. Kullberg (2924), C. Moore (2935).**

The Adies are exhibitors of the patent surveying compass. This instrument consists of a magnetic needle, accurately centred, and so delicately suspended as to require verniers, the 3-inch size having greater accuracy than the largest circumferentor, and if with vertical arc forming a complete theodolite.—Adie's patent semicircle (a sextant), on a new system of reflection, reading the angles in full instead of half degrees, and any angle to one hundred and eighty degrees. This has the practical effect of halving the size of the instrument, greatly reducing the cost and enclosing all the reflectors from derangement or weather.—Adie's patent telemeter for measuring distances by a single observation. The base is represented in the instrument itself, which may be 1½, 3, or 6 feet long, according to the accuracy required or distances measured. The instrument is a system of two telescopes, the object glasses being placed near the opposite extremities, and on the same side of an interior and exterior tube, with rays directed at right angles, and brought together into one eye-piece, the two halves of the object looked at being seen simultaneously in the two half fields brought from each telescope to the eye-piece and made to coincide, the angle of convergence of the telescopes being measured on an arc at the end of the two tubes.

Yeates's prismatic compass is convenient. This little instrument is intended for the use of the surveyor, the miner, and the engineer, when angles are required to be taken with speed and accuracy. Inside the box is a silver ring, fast to the needle, divided to 30′, which gives the magnetic bearing even when held in the hand. When placed on its tripod stand, the spirit level is used to make the axis vertical and the limb horizontal, when all angles can be measured either with the silver ring, or divided limb: the limb gives the angles independent of the magnetic needle.

1st. The artificial horizon, exhibited by Mr. R. C. Forbes, is a useful instrument. It frequently happens at sea that heavenly bodies may be distinctly seen when the sea horizon is obscured by fog. In order to obtain an artificial horizon several kinds of instruments have been invented to attach to the sextant or quadrant for the purpose; but all have failed to be of any practical use, in consequence of requiring the objects to be kept in one in order to obtain the position of the true horizon.

The sextants of T. W. Baily, which have been verified by the Kew Observatory are very superior instruments.

OPTICAL INSTRUMENTS.

Exhibitors.—**E. Burton (2869), Chadburn Bros. (2875), J. P. Cutts, Sutton, and Son (2887), P. Frith and Co. (2899), G. Gowland (2902), Right Honourable R. Lowe (2930), Negretti and Zambra (2939), J. Orchard (2942), M. Pillischer (2945), T. Ross (2952), N. Whitehouse (2991), J. Braham (2862), J. Hughes (2918), Smith, Beck, and Beck (2964).**

The Right Hon. Robert Lowe, M.P., exhibits spectacles which magnify without glass or any other refracting medium.

These spectacles answer the purpose of common goggles—that is, protecting the eye from lateral pencils of light; they also have considerable magnifying powers. The size of an object, as seen, depends upon the angle which it subtends at the pupil of the eye. If we can remove the vertex of this angle from the eye, we make the angle more obtuse and the object larger. It also follows that the smaller the hole the greater the magnifying power, but of course less light is admitted. It is believed these spectacles, in addition to their utility for reading, might be used with advantage by lapidaries and watchmakers. They have been of the most essential service to the inventor for a period of ten years.

Binocular instruments are manufactured by Negretti and Zambra of a superior character. The lenses of these instruments are constructed of the finest rock crystal, cut and worked so as to insure the highest perfection, both in magnifying and defining power. The superiority of crystal lenses over ordinary glass, consists in the surfaces always remaining brilliant in all climates, not efflorescing or becoming dull and cloudy by exposure to the action of the atmosphere, and from the extreme hardness of the crystal not liable to be scratched. These instruments, the advantages of which will be appreciated by any who have had experience in the use of binocular glasses on foreign service, are offered by Negretti and Zambra at a price not much advanced on that of ordinary glasses.

Messrs. Murray and Heath exhibit decentrated spectacles, as recommended by Dr. Giraud Tenlon. These are the first made in England.

The stereotrope, an instrument, the invention of Mr. William Thomas Shaw, consists in an application of the principle of the stereoscope to that class of instruments variously termed thaumatropes, phantascopes, phenakistoscopes, &c., which depend for their results on "persistence of vision." In these instruments, as is well known, an object represented on a revolving disc, in the successive positions it assumes in performing a given evolution, is seen to execute the movement so delineated: in the stereotrope the effect of solidity is superadded, so that the object is perceived as if in motion and with an appearance of relief as in nature. Its construction, when the refracting stereoscope is made use of, is as follows:—Eight stereoscopic pictures of an object—of a steam-engine, for example, taken in the successive positions it assumes in completing a revolution—are affixed, in the order in which they were taken, to an octagonal drum, which revolves on a horizontal axis beneath an ordinary lenticular stereoscope, and brings them one after another into view. Immediately beneath the lenses, and with its axis situated half an inch from the plane of sight, is fixed a solid cylinder, 4 inches in diameter, capable of being moved freely on its axis. This cylinder, which is called the eye-cylinder, is pierced throughout its entire length (if we except a diaphragm in the centre, inserted for obvious reasons) by two apertures, of such a shape, and so situated relatively to each other, that a transverse section of the cylinder shows them as cones, with their apices pointing in opposite directions, and with their axis parallel to, and distant half an inch from, the diameter of the cylinder. A plane mirror is employed to assist in the illumination of the pictures. The eye-cylinder, by means of an endless band or a train of wheels, is caused to make exactly four revolutions to one of the picture-drum, whence it is evident that the axes of its apertures will respectively coincide with the plane of sight four times in one complete revolution of the instrument, and that, consequently, vision will be permitted eight times, or once for each picture. The cylinder is so placed that at the time of vision the *large* ends of the apertures are next the eyes, the effect of which is that when the *small* ends pass the eyes, the axes of the apertures, by reason of their eccentricity, do not coincide with the plane of sight, and vision is therefore impossible. The width of the apertures at their small ends is one-eighth of an inch; at their large ends an inch and a half. The picture-drum being caused to revolve with the requisite rapidity, the observer will see the steam-engine constantly before him, its position remaining unchanged in respect of space, but its parts will appear to be in motion and in solid relief, as in the veritable object. The curious and beautiful effects of the phenakistoscope are wonderfully enhanced by the addition of solidity in this instrument.

TELESCOPES, &c.

Exhibitors.—J. Buckingham (2867), W. and J. Burrow (2868), J. Casartelli (2873), T. Cooke and Sons (2880), J. H. Dallmeyer (2888), A. A. Hely (2907), J. Parkes and Son (2943), C. E. Bagot (2851), T. Slater (2961), Spencer, Browing, and Co. (2962), T. Grubb (2905).

Messrs. Chadburn Bros., of Sheffield, exhibit ship telescopes with a new day and night adjustment. Mr. J. H. Dallmeyer exhibits some beautiful telescopes.

"Astronomical and terrestrial telescopes," two of the former mounted on new forms of fixed and portable equatorial stands. The first (fixed) having a loose hour-circle (Airy's), and driven by clock work, with a going gravity-barrel, the form of pedestal and position of clock being such that the clock weight descends in the principal centre of gravity of the instrument, thus adding to its steadiness, and is so situated as not to occasion any inconvenience to the observer. T. Grubb exhibits a beautiful large equatorial telescope. J. Buckingham has in his instrument remarkably fine object-glasses. T. Cook and Son show, in their telescopes, most excellent glasses and mounting.

SUNDRIES.

Exhibitors.—W. Ackland (2845), W. D. Bellhouse (2856), Benhams and Froud (2857), Bland and Co. (2859), Bolton and Barnitt (2861), D. S. Brown (2866), T. O. Buss (2870), T. E. Butters (2871), J. E. Cook (2879), F. B. Cox (2882), F. J. Cox (2883), Rev. G. Crabbe (2884), W. G. Cutter (2886), De Grave, Short, and Fanner (2892), De la Rue (2893), Mr. Desvignes (2895), R. C. Forbes (2898), J. T. Goddard (2901), J. J. Griffin (2904), T. Grubb (2905), W. D. Hart (2906), W. S. Henley (2908), J. Hicks (2911), Hudson and Sons (2917), Jackson and Townson (2919), H. Johnson (2920), Kiessler and Neu (2922), Ladd and Oertling (2926), J. Laing (2927), Dr. E. Lankester (2928), J. Lewis (2929), Dr. Macdonald (2931), M. Marriott (2932),

H. Minchin (2934), J. Mortimer (2936), J. Musselwhite (2938), J. L. Pulvermacher (2947), J. Sax (2954), W. T. Shaw (2958), S. W. Silver and Co. (2960), E. Smith (2963), C. P. Smyth (2965), A. Spratt (2966)), J. Spratt (2967), P. Stevenson (2969), Suffell (2972), W. Sugg (2973), J. Tree and Co. (2976), A. Varley (2979), L. L. and H. P. Vulliamy (2982), H. Watson (2986), A. Yeates (2995), J. Young (2997), International Decimal Association; Professor Levi (2998).

Amongst the variety of articles which are here grouped together it is difficult to select any for the brief notice which can be afforded. There is an interesting case sent by Mr. J. Young of moulded carbon for electrical purposes. This manufacture is a substitute for retort carbon, and intended to make us independent of this precarious source of supply. The blocks are all moulded and composed of an intimate mixture of certain proportions of ground coal, coke, and sugar. They can be made of any size or form. The samples sent are in plates, flat, square, and hexagon bars.

Mr. H. Johnson exhibits a volutor contrived for the purpose of facilitating, by means of mechanical arrangements, the drawing of volutes; also a deep-sea pressure gauge and a deep-sea thermometer to be run simultaneously with the pressure gauge for the purpose of determining how much of the variation in volume of water indicated by the latter is due to variation of temperature, and may be considered as an indispensable adjustment to it.

Sikes' hydrometers as used by the Excise are also exhibited in this Class, the principal collection of which are contributed by Mr. T. Buss, of Upper East Smithfield, Tower Hill, who also shows a large collection of saccharometers used by brewers.

Amongst the curiosities of mechanism, Messrs. Chadburn Brothers are exhibitors of working models of locomotive, and stationary engines with boilers, steam-pipes, and connections complete. One of these is a great curiosity, and highly illustrative of the perfection to which mechanical and engineering skill has been brought. This wonderful little machine is a vertical engine with boiler and steam-pipes complete, made so that simply the heat from the bowl of a tobacco-pipe will raise sufficient steam in the boiler to work the engine. The entire length of it is not two inches. They also exhibit globes illustrating the position of gnomons of sun-dials in different latitudes.

Messrs. Kiessler and Neu have a model of a very ingenious wood-splitting machine.

Mr. H. Watson exhibits safety-lamps, and the hydro-electric machine of Sir W. Armstrong.

Mr. H. Desvignes has an ingenious modification of gyroscope weighing 1½ lb., when properly spun 4 or 5 lbs.; suspended on its axis will not for a time alter its inclination, although two or three grains would be sufficient to do so when not spinning. He also exhibits an electro-magnetic model to show the force antagonistic to the converging of the axletrees of railway carriages on rails that form part of a curve. Professor Smyth exhibits his application of the Gyroscope to render instruments stationary at sea.

The Rev. G. Crabbe exhibits a cheap instrument to show the meridian transit of the sun, for the use of country watchmakers and others: easily made by any tinman, more accurate than the sun-dial, and serving for all latitudes. The instrument being fixed due north and south, and on a level surface, the ray of light from the pin-hole passes so quickly over the meridian line as to show apparent time at noon to within a few seconds. The side on which the line is drawn is made circular, so as always to present a plane surface for the ray to fall on. The ray consequently always shows a round spot on the line. The instrument might be made smaller, but the ray, being then shorter, would pass less quickly over the line, and it would be by so much harder to tell the moment when it is bisected by the line. In this instrument there is nothing that can get out of order, and it is recommended where simplicity, cheapness, and great accuracy are desired.

John Braham, optician, exhibits barnacles and spectacles from their earliest invention, including those of Scheiner, Janson, Sir Isaac Newton, Drs. Kitchener, Wollaston, and

Herschel, up to the patent granted him, August, 1861, for his improved pantoscopic, antiophthalmioscopic, and rifle spectacles, and helical spring eye-glasses. A dissected model of the eye and retina is also exhibited in this interesting collection.

PROFESSOR ABEL'S FUZES.

These interesting and ingeniously-contrived fuzes are exhibited by Mr. Ladd. Professor Abel has published a clear account of the principles involved, and of the manufacture of these fuzes, under the title of "Account of Recent Researches on the Application of Electricity from different Sources to the Explosion of Gunpowder." The priming composition of these fuzes consists of a very intimate mixture of the subphosphide of copper, chlorate of potassa, and levigated coke; the latter substance being employed to add to the conducting power of the mixture. This mixture is so sensitive that the currents obtained from magnetic instruments of inferior power, such as the small American magneto-electric medical apparatus, will readily ignite it. With a modified and comparatively cheap magneto-electric machine which is made by Mr. Ladd, several holes can be fired in a mine or quarry simultaneously with a greatly increased effect.

POLARISCOPES.

Exhibitors.—**W. Bestall (2858), W. H. Darker (2890), Horne and Thornthwaite (2916).**

Messrs. Murray and Heath are also exhibitors of an improved apparatus for circular polarization. The arrangement insuring the passage of the light directly through the fluid under examination.

Mr. Darker, who is well known for the delicacy with which he manufactures polarizing apparatus and examples, is an exhibitor of a very nice series; and Horne and Thornthwaite contribute to illustrate the same beautiful phenomena.

The Herapathites—the *iodide of quinine*—so called from the circumstance that the polarizing power of these crystals was discovered by Herapath, are exhibited by Horne and Thornthwaite.

LIGHTHOUSE APPARATUS.

Exhibitors.—Chance Bros. (2876), F. H. Holmes (2914), W. Ladd (2925), Wilkins and Co. (2993).

Chance Brothers are exhibitors, in the Nave, of a dioptric revolving apparatus of the first order, constructed according to Mr. Thomas Stevenson's holophotal improvement of the system of Augustin Fresnel.

This apparatus is formed of an eight-sided frame, in the centre of which the flame is placed. Each side comprises a compound lens, and a series of totally-reflecting prisms, both above and below the lens; all these prisms, as well as the rings of the compound lens, being concentric round a horizontal axis passing through the centre of the lens. The result is, to condense the light proceeding from the central flame into eight beams of parallel rays, without the aid of unnecessary reflections or refractions, so as to produce the maximum effect at sea.

Light-room and Lantern.—The light-room is made of cast iron; it is 7 feet high, being cylindrical within, and having externally sixteen sides, which are alternately large and small, to suit the lantern which it supports. It is provided, *outside*, just beneath the lantern, with a gallery or balcony, on which the keepers can stand to clean the lantern panes, and also with an *inside* gallery for the service of the apparatus. The inside of this light-room is lined with mahogany.

The lantern is formed, 1st, of sixteen standards, alternately inclined to the right and left: they are made of wrought iron, covered with gun-metal facings, by which combination the greatest strength and the minimum interception of light are obtained, together with the usual protection from the sea air. 2nd, of gun-metal astragals, in two tiers, and of gun-metal sole-plates and sills. 3rd, of a double copper dome, supported on iron rafters. The whole is surmounted by a revolving copper ball, carrying a wind-vane. The panes of the lantern are purposely omitted, to facilitate inspection of the apparatus.

A square cast-iron pedestal, with glazed doors, containing the clockwork for imparting rotatory motion to the apparatus. By a contrivance, communicated to the manufacturers by

Professor Airy, and for the first time used in lighthouse machinery, the *winder* is so constructed as to maintain an uniform speed of rotation, without any check during the winding up. In other particulars the plan of the pedestal and of the clockwork is in accordance with the Scotch system.

A revolving carriage, being an arrangement of rollers and guide rollers, to give the least possible amount of friction, whilst it maintains the perfectly vertical position of the apparatus.

A fixed cast-iron table, on which the oil lamp is placed, and on which the keeper stands for the service of the lamp.

The oil lamp is a novel kind of "pressure lamp," and consists of a turned gun-metal cylinder, in which the piston that forces the oil into the burner is worked by a weight placed *outside* the cylinder, instead of *inside*, as hitherto.

Each of the four concentric wicks of the burner is supplied with oil by two independent feed tubes, communicating with the main pipe.

A floating revolving light, for positions where a fixed lighthouse could not be conveniently placed, constructed by Wilkins and Co., is also exhibited in the Nave. The principal improvement in this light consists in constructing the machinery to work beneath the deck instead of in the lantern, as formerly. There is also an advantage in the method of constructing the lamps and the gimble-work. The apparatus is arranged for exhibiting three reflectors in a face of three glasses, coloured red, white, and green.

With this is associated a fourth order of holophotal light, an arrangement which secures the reflection of all the rays; and an apparatus constructed for exhibiting a powerful flashing light. There is, in addition, a direction light of recent construction, for harbours or railways, seen at a distance of 18 miles; and a 36-inch silver-plated parabolic reflector for lighthouse purposes, of the powerful range of 25 miles.

A very clever focus-measurer for lighthouses is exhibited by Mr. Ladd.

In Vol. I. of *Handbook*, pages 275 and 374, will be found some description of the applications of electricity to lighthouse illumination, as shown by Holmes.

PHILOSOPHICAL INSTRUMENTS IN USE AT KEW OBSERVATORY.

SELF-RECORDING MAGNETOGRAPHS.

The object of these instruments, which were planned by the late Mr. Welsh, is to exhibit continuously, by means of photography, those minute changes which are continuously taking place in the three elements of terrestrial magnetism.

1. In the magnetic declination or direction, in which a compass needle points.

2. In the intensity of the horizontal component of the earth's magnetic force, or of that force which tends to pull a compass needle round to its true direction.

3. In the intensity of the vertical component of the earth's magnetic force, or of that force which tends to make the north end of an unweighted magnetic needle dip downwards.

The following is the method by which this result has been obtained. A circular mirror will be observed for each of the three magnets, or, rather, two separate semicircular mirrors, one of which is rigidly connected with the magnet itself, while the other is attached to the marble slab. Light from an illuminated slit is made to fall upon a lens, after passing through which it strikes the two semicircular mirrors above mentioned, and is then reflected through a tube upon a sheet of sensitive paper placed in the central box. This paper is prepared according to the waxed-paper process, and is so placed with regard to distance, as to be at the congregated focus of the slit of light, with respect to the lens used. In consequence of this, an image of the slit would, in a darkened room, be seen upon the sensitive paper, or, rather, two images would be visible, the one due to the light which is reflected from the movable mirror, and the other to that which is reflected from the fixed one. It will be seen that if the sensitive paper is sufficiently distant from the mirror, a very slight angular change in the position of the latter will cause a very considerable alteration in the position of the corresponding image on the sensitive paper, and that the distance between the two images, the fixed, and the movable, will enable us to determine at any instant the exact position of the magnet. By means of a hemi-cylindrical lens, placed in the central box, these two images of the slit are condensed into two dots of light, in which state they fall on the sensitive paper. This paper is wrapped round a cylinder, which, by means of clockwork, is made to perform one revolution in twenty-four hours. The fixed dot of light will thus describe a straight line, while the movable dot will describe a curved one, and, by measuring the distance between these two lines, we shall be enabled to ascertain the state of the magnetic element at any time.

There are three cylinders in the central box, corresponding to the three magnetic elements, and these are all driven by the same clock. The magnet employed for the purpose of estimating the changes which take place in declination is suspended in its natural position. But, in order to estimate the changes which take place in the intensity of the earth's horizontal force, the magnet employed is suspended by two threads or wires, by which it is twisted into a direction at right angles to its natural position, where it is kept at rest by the balancing of the two forces, namely, the force of twist on the one hand, and the horizontal component of the earth's magnetic force on the other. Should this latter force either increase or diminish a little, it will cause a corresponding change in the position of the magnet, and, consequently, of the movable dot of light on the sensitive cylinder.

In order, again, to estimate the changes which take place in the vertical component of the earth's magnetic force, the magnet is balanced on a knife-edge of agate, on which it is made to rest in a horizontal position, the tendency of the north end to dip being counterbalanced by a weight. Should the earth's vertical magnetic force become stronger, the north end of the magnet will be pulled down; on the other hand, should it become weaker, the weight will preponderate and pull down the south end of the magnet.

Observations independent of photography may also be made by these instruments by means of telescopes, which transmit to the eye the images of a scale as reflected in the fixed and movable mirrors. These images, by their relative position in the field of view, will enable us to determine the exact position of the magnets.

The proper position of these magnetographs in an observatory is with the line joining the three pillars, in a direct perpendicular to the magnetic meridian.

The instruments now exhibited have been constructed by Mr. P. Adie, optician, 395, Strand, London.

INSTRUMENT EMPLOYED IN TABULATING THE TRACES GIVEN BY THE MAGNETOGRAPHS.

The magnetograph curves run on from about 10 A.M., or 22 h. astronomical time of one day, to the same hour of the next day, the exact time of its commencement and end being noted for each curve. The calculating instrument has therefore a time scale commencing with 22 hours. This scale is movable round a centre, which centre is also movable in a horizontal direction. The latter motion enables us to set the scale, so that that part of it which is indicated by the travelling pointer, when the eye-piece is over the commencement of the curve, may denote the corresponding time. On the other hand, the motion of the scale round its centre will enable us to incline it in such a manner as to represent accurately, by its horizontal projection, the time-scale of the particular curve we are calculating from this being an element which varies slightly from the different curves. There are two eye-pieces made to destroy parallax, one for the zero line, and the other for the curved one, the latter line being generally about 2 inches distant from the former. These two eye-pieces are rigidly connected with one another, being exactly 2 inches apart. They traverse along a scale, and it is easy to see how by this means we may determine accurately the distance between the curve and zero line, while the corresponding time is read off by the travelling pointer. This instrument was devised by Mr. Beeteley, and the present specimen has been constructed by Mr. W. J. Gilson.

The Unifilar Magnetometer.

This serves the double purpose of enabling us to estimate the magnetic declination and the horizontal intensity of the earth's magnetic force. We obtain by it the absolute value of these elements at the time of observation; while the small changes in their values, which are continually occurring, are registered by the self-recording magnetograph. In order to obtain the absolute magnetic declination, a hollow cylindrical magnet is employed, having a flat piece of glass, with a scale engraved on it, fitted into its south end, while a lens is fitted into the north end having the glass scale in its chief focus. When viewed through a telescope from the north it is evident that we shall obtain a magnified representation of the scale in the field of view.

Having noted that division of the scale which coincides with the vertical wire of the telescope, we next reverse the magnet and again note the coincident division—the mean of these two readings will give us the position of the magnetic axis, or of that line which really points to the magnetic meridian when the magnet is freely suspended. When we have thus obtained the position of the magnetic axis we set the instrument so that this axis crosses the vertical wire of the telescope, and read the vernier of the horizontal circle. We then turn the instrument round, and by means of the transit mirror properly adjusted throw the sun into the field of the telescope, and note from a chronometer the time of his passage across the wire. We are thus enabled to determine the astronomical bearing of the telescope for this position of the horizontal circle, and having read the vernier, we may easily find what was the true bearing of the instrument when the magnetic axis crossed the wire of the telescope, and thus obtain the absolute declination.

To find the earth's horizontal force we must first of all determine accurately the time of vibration of a magnet of which the moment of inertia, temperature correction, and inductive coefficient are known. This time will depend conjointly on the intensity of the earth's horizontal force, and on the strength of the magnet, and this observation will therefore give us the product of these two forces. We next take the magnet which we have been vibrating, and attach it by a rider to the horizontal bar at a given distance from another magnet freely suspended in the central box. This suspended magnet will not rest in the magnetic meridian, but will assume a position depending on the relative intensity of the earth's force which pulls it to the meridian, and on that of the magnet which pulls it in a direction perpendicular to the meridian. Its position of rest will thus enable us to ascertain the ratio between the earth's horizontal force and that of the deflecting magnet. But we have already obtained the product of these two forces; hence, knowing their product and their ratio, we are able to obtain the value of each, and may thus find an expression for the amount of the earth's horizontal force. The unifilar here exhibited has been constructed by Mr. W. J. Gilson.

DIP CIRCLE WITH REV. DR. LLOYD'S ADJUSTMENT.

This instrument may be employed either to determine the magnetic dip, or to find the earth's total magnetic force. For the first of these purposes it is furnished with two needles, each 3¼ inches long, the centres of gravity of which coincide as nearly as possible with their centres of suspension. The axle of the needle employed is made to rest on two agate planes, and its position is concentric with, but behind (as regards the observer), the vertical divided circle on which the dip is read. A moveable arm, concentric with this circle, has two microscopes attached to it, the distance between them being 3¼ inches, so that either extremity of the needle can be brought into the centre of the field of the corresponding microscope.

In taking an observation the needle must be made to move in the plane of the magnetic meridian. In order to find this plane the circle is turned round until the needle assumes a vertical position, in which case it moves in a plane at right-angles to the magnetic meridian. If the circle be now turned round 90° the instrument will be in the required plane. We then observe the needle in the four following positions:—

1.	Face of instrument,	east	Face of needle to face of instrument.
2.	Ditto,	west	
3.	Ditto,	west	Back of needle to face of instrument.
4.	Ditto,	east	

And having reversed the poles of the needle we make other four observations of a similar character.

The mean of all these will give a result freed from all errors due to imperfect balancing of the needle, &c.; and if similar observations be made with the other needle the mean of the two will represent the magnetic dip with great accuracy.

The earth's total magnetic force is found from the dip circle with Dr. Lloyd's adjustment in the following manner. A magnetic needle is loaded with a small weight until it rests in a position as nearly as possible perpendicular to the line of dip. Its position will give us the means of finding the product of its magnetic moment with the earth's total magnetic force. The needle is then removed and attached to an arm at right angles to that which carries the microscopes, it being now used to deflect another needle substituted in its former place. The moveable arm is next turned round until the deflected needle assumes a position at right angles to the deflecting needle, so that the extremities of the former are viewed by the microscopes. The position of the deflected needle enables us to find the ratio between the magnetic moment of the deflecting needle and the earth's total force, and having already obtained the product of these two quantities we are thus enabled to ascertain the earth's total force. In the ordinary use of this instrument a central station is chosen, such as Kew, where the value of the total force is independently found by means of horizontal force and dip observations, and this value is employed to furnish a constant necessary in the reduction of the observations taken by Dr. Lloyd's method. When this constant has been once obtained, the instrument, if carried to any other place where the total force has assumed a value different from that at Kew, will give this difference with great accuracy. This process is particularly useful in high latitudes, where the horizontal magnetic force being small, the length of the time of a vibration forms an objection to the usual method. The dip circle now exhibited has been constructed by Mr. Henry Barrow, 26, Oxendon Street, London.

ANEMOMETER.

This is an improved form of the Rev. Dr. Robinson's anemometer suggested by Mr. R. Beckly of Kew Observatory, and has for its object to record continuously the velocity and direction of the wind, all the apparatus being on one support, and not on two, as was previously the case. In order to accomplish this we have two vertical shafts working independently the one within the other. The outer shaft is connected with a *windmill governor* which records the direction of the wind, while the inner one is connected with the hollow cups, which Dr. Robinson has shown will always move round the convex side first, with a velocity equal to one third of that of the wind then blowing. The windmill governor works a cylinder with a spiral slip of brass coiled round its surface, and this serves as a pencil by bearing against a sheet of metallic paper also coiled round another cylinder. The point of contact of the brass pencil and the paper will thus depend on the direction of the wind. The cylinder round which the paper is wrapped is driven by clockwork once round in 24 hours, so that the brass pencil will describe a curved line by means of which the direction of the wind may be ascertained at any moment. Another part of the paper is made available as a means of recording the space travelled over by the wind, and this is done in the following manner:—The shaft connected with the hollow cups is made to communicate its motion by means of a suitable train of wheels to a cylinder, covered as in the previous instance with a spiral slip of brass, one revolution of which is made for every fifty miles travelled over by the wind. We have thus two cylinders, each having spiral slips of brass which work side by side, upon a large cylinder covered with metallic paper, the one of these giving the direction of the wind, and the other the space over which it has travelled. One advantage of this arrangement is, that we should be able to obtain a continuous record of the wind's direction, even though this should veer round the compass several times in one day.

Kew Standard Barometer.

In an instrument which is to be used for the purpose of an Observatory standard barometer, it is desirable to have a tube with a wide bore in order to avoid capillarity. In this case the ordinary plan of boiling the mercury cannot be adopted, for it has been found impossible to do so without soiling or breaking the tube.

Under these circumstances the late Mr. Welsh proposed that the tube to be used should be well cleaned, fitted with an open capillary tube, exhausted of its air at a high temperature, and that when in this state the capillary tube should be closed. The tube is then laid in an inclining position, and its capillary termination broken under a surface of pure mercury, which fluid will then rise and fill the tube.

Finally, the capillary termination is detached, and the instrument being inverted is found to serve the purpose of a barometer. As used at Kew Observatory, there is no scale attached to this instrument, but the height is read off by a telescope which travels up and down a vertical scale. The tube now exhibited has been prepared by Mr. Casella, Hatton Garden, and is fitted with a scale in the ordinary way. Another tube is also exhibited filled with mercury, and retaining its capillary appendages in order to illustrate the process.

Spiral Tube Barometer.

This instrument has been made by Mr. J. Hicks, Hatton Garden, to whom, along with Mr. Beckly, is due the idea of its construction.

It will easily be seen that the spiral arrangement provides us with a very open scale, while the spiral brass slip affords us an accurate method of reading the same.

KEW STANDARD THERMOMETER.

Thermometers are graduated at Kew on the following principle. A small column of mercury, say about 10° or 12° is detached, and the length which it occupies is measured very exactly at the different parts of the tube. We are thus enabled to ascertain the relative bore of these different portions, and hence to know the true length of 1°, at any point of the scale.

APPARATUS USED IN COMPARING THERMOMETERS WITH STANDARD.

A Kew standard thermometer and six other thermometers, intended for comparison with the standard, are attached to the central stand. It is supposed that these instruments have previously had their errors, at 32° Fahr., ascertained by immersion in melting ice. Water, say of 42°, is put into the glass jar, and an agitator, which fits round the central stand without touching it, is employed to agitate the water so, that all portions of it may have the same temperature. The thermometers beginning with the standard are then rapidly read by an observer, an assistant being employed to note the reading, and the same process is then repeated backwards, ending with the standard.

The glass jar is moveable on a vertical axis, so that while the observer keeps his seat, he may easily bring any thermometer opposite him.

By this process we obtain corrections of thermometer at 42°, 52°, 62°, 72°, 82°, and 92°.

This interesting and instructive description of these important instruments has been obligingly communicated by Mr. Stewart, of the Kew Observatory.

CLASS XV.—HOROLOGICAL INSTRUMENTS.

Number of Exhibitors, 95. The Prescott Committee, 23.

SITUATION OF CLASS.—*This Class is placed in the Gallery of the North Court, between Surgical Instruments and Paper and Stationery.*

A work of this character is not intended to explain the construction of clocks and watches; nor is it contemplated to examine with any exactness the value of the improvements introduced. The purpose is merely to direct attention to those things which present the largest amount of novelty. This statement is rendered necessary by the large number of communications which have been forwarded to the author, many of which he deeply regrets being unable to use.

The exhibitors' names are not given, because they do not admit of subdivision, and therefore nothing is gained, and space is absorbed.

Time is made one of the emblematic objects in the architecture of the Exhibition building.

The great dial around the stained-glass window at the eastern end of the Nave, measuring nearly forty feet in diameter, is worked by a clock made by the firm of Dent. In this clock the aim has been to show that the hands for an immense dial can be worked by a comparatively small movement.

In the Eastern Transept they have a specimen of the turret clock, striking the hours on a bell, weighing between three and four tons, and quarters on smaller bells. They have also at work, adjoining this clock, a smaller one, showing the time only, the construction of which demands special attention. The maintaining power which continues the performance of the clock, while winding, has the advantage of exerting an equal force during the whole time of winding, as well as the capability of multiplying the winding power at discretion. The remontoire in this clock is driven by a weight hanging from a drum, thus equalizing the force, and thus avoiding the effects of a varying temperature experienced in a spring remontoire.

The special peculiarities in Mr. Benson's clock, in the Central Avenue, are a new double lever remontoire,—the application of which principle diminishes the friction or retarding force and will allow of great motive power, even to the extent of 20 tons being used without disturbing the time-keeping qualities (for it will be seen in all cases where the works of a clock are at a great distance from the dial, as is the case with this clock, the outer dial of which is at 300 ft. distance—that a great motive power is requisite, and the advantage of being thus able to employ it, affords facilities for obtaining results superior to that of any other clock yet manufactured). It has a compensated two-seconds' pendulum, and all the pivots run in gun-metal bosses, fitted in plummer blocks; these plummer blocks have never been applied to clock-work before, and their advantages are, that they allow of any portion of the clock-work being removed without disturbing the whole, either for cleaning or otherwise: every wheel of the clock is made of gun-metal, and the finish is of that description that it appears to justify Mr. Benson's assertion that it is equal, if not superior, to any clock either in this or any other country.

The clock has chimes, which are those of St. Mary's at Cambridge, remodelled, so that by their intonation they may denote first, second, or third quarters, as the case may be: the weights of the clock are in the eastern corner of the Exhibition, some 200 feet from the works, and are carried under the floor, and connected by means of pulleys: they weigh several tons; the five bells together weigh fifty hundred weight.

Mr. J. Bennett is an exhibitor of a fine collection of clocks and watches.

Mr. C. Frodsham has a collection, certainly remarkable for the excellence of workmanship displayed; it consists of astronomical clocks—the new equation compensation balances—with chronometers and watches of the highest character.

Mr. B. Marriott exhibits many exceedingly well-made watches of various descriptions.

Parkinson and Frodsham's chronometers and astronomical clocks, are beautiful instruments.

Mr. Hislop is an exhibitor of a clock which has two dials, one showing mean time and the other sidereal time: the arrangement by means of which this is effected is capable of application to any clock, without alteration of the existing movement, so that sidereal time may be shown either on the principal or supplementary dial.

Mr. J. Walker has a collection of watches, amongst which will be found his *Crystal Case Watch*, which is so called from the face or front being protected by a perfectly flat and thick crystal, thereby removing the objection to hunting-watches, that of having to open the cover in order to see the time; and by the aid of a reflecting bevel on the inside of the dial, they show the time much more clearly than an ordinary open-face watch, and is most admirably adapted for rough or any kind of usage.

Mr. John Forest exhibits some watches of excellent manufacture. The only object which has important claims to novelty, is an ordinary one-pin lever movement, with compensating balance and isochronal spring: the balance is so constructed, as without any artificial adjustment to obtain a perfect measurement of time in any position.

Armstrong's improved watchman's detector clocks should be examined, comprising an ordinary office time-piece and watchman's clock combined, entirely self-acting. These clocks indicate every half hour if the watchman has been upon duty, and registers his attendance or neglect, and requires no attention except the winding up once every week.

Armstrong's improved steam or speed clocks, for use in factories and mills of all kinds, show whether the steam-engine has been worked at the proper speed, and also compel the engineer to work at a regular pressure, or register his inattention. By the use of these the proprietor is enabled to see that the proper amount of work is done, and also that it is done regularly, by which means much better work is produced.

Mr. James Young, of Knaresboro', exhibits his improvements in the construction of chronometers and watches. The object of the improvements is to give a more easy, ready, and safe means of detaching and replacing the chronometer, lever watch, clock, and other timekeepers, by which plan much time, trouble, and expense will be saved in repairing clock machinery; as the top plate, bars and cocks may be taken off, and any one or the whole of the smaller wheels, escapement, &c., &c., may so be taken out, repaired and replaced without letting the spring down when wound up, or removing the chain from the fusee, or running the wheel-work down; and at the same time it can be accomplished with the greatest safety.

Rotheram and Sons exhibit instructively a complete watch taken to pieces, every part of which will be shown in the various stages of manufacture; thus giving a practical history of the process by which rough pieces of brass, steel, &c., are gradually changed into finished plates, wheels, pinions, &c.

Mr. Delolme has marine chronometers, an astronomical regulator, in plate-glass and ormolu-case of an entirely new design. Gravity escapement, with Henry Delolme's improvement. The pendulum suspended by friction rollers. Mercurial pendulum and thermometer, and a collection of first-class watches.

The collection of clock, chronometer, and watch jewels, exhibited by Samuel Holdsworth for inspection, consists of diamonds, rubies, sapphires, chrysolites, garnets, and acquamarines, which comprises all the stones used for horological purposes. There are jewel-holes of every description; clock and chronometer tablets; ruby rollers for the duplex escapement; ruby cylinders for horizontal movement; solid chronometer rollers which serve the purpose of impulse and roller combined; ruby pins, flatted, oval, and triangular; caps and points for marine compasses; and drawplate holes, capable of drawing gold wire from 1000 to 2500 yards to the ounce.

The jewels are of every admittable size, varying in their differences some 10,000 degrees, the smallest of which, in order that the public may form some idea of their beauty and mechanism, are placed under a strong magnifying power. There are also some samples of precious stones in their original state.

Thomas Heyes is an exhibitor of pinion wire in steel and brass. A few samples of the various numbers of teeth are exhibited.

Steel click-wire is a flattish wire with a concave face, and squares on the back, and one kind round on the back.

Round bright steel wire, angular, square, and flat wires, are also displayed. These wires are used in the manufacture of watches and clocks, and some of them in the manufacture of gas-meters, lamps, and microscopes.

A beautiful series of watch and pendulum springs are contributed by Ganevol and Collard.

In addition to some specimens of English-made watches, Messrs. Wales and McCulloch exhibit a perpetual-calendar watch of novel and very beautiful construction, with the improved jewel roller escapement, which, while marking the hours, minutes, and seconds, shows accurately the day of the week, the date of the month, and the month of the year: the day-of-the-month wheel being ingeniously arranged to regulate the hand for the long and short months, and faithfully registering, without alteration, even the 29th of February in Leap-year.

The pearl watch-dials, exhibited by Mr. Charles J. Hile, are very beautiful.

Amongst the many advantages which mother-of-pearl possesses over every other substance yet used for this purpose, are,—its extremely beautiful natural appearance; freedom from tarnish or other discolouration; its capability of being engraved, ornamented, and sunk to any style; durability; cheapness.

Captain H. B. Coathupe exhibits his "everlasting clocks," an improvement on the mercurial time-keepers. This clock consists of an inner tube of glass, plugged near the ends, which are open. There is a little mercury (about an inch) in the tube, which is hermetically sealed up in a covering tube. Being hung upright, the motive power is obtained from the mercury forcing by its weight the air through the lower plug, yet being controlled by the suction through the upper. The lower level of the mercury is taken to indicate the time, on an index of wood and paper, iron, glass, enamel, &c., to which the glass tube is attached by spring clips, through which it slides so as to admit of easy adjustment. For cheapness of production this clock is unrivalled, being sold at 1s. and upwards.

The *silent night-lamp clock* is a modified form of the above.

Captain Coathupe also exhibits an invention by Mr. Frank Waltham, which he terms metallography. It is intended to supersede other processes of printing, engraving, &c.

Mr. S. A. Brook certainly assists the trade by his exhibition of a complete set of jewel-hole gauges, to measure pivots or holes. They have been invented by him to meet a very pressing want of all watchmakers, especially those residing at a distance from London. At present the watchmaker is situated as the carpenter or mason would be; without the yard-measure he would have to carry a piece of timber or stone to show the size required, instead of conveying his wants by figures—saving carriage, risk of loss, &c. It is also hoped that it may lead to uniformity of size for new watches. The export watch jewel-hole case, with set jewels, arranged and sorted, must be equally valuable.

A set of gauges are also sent by Ehrhardt, invented by himself, for measuring the lever escapement. The one of these instruments will show at one time the angle of the pallets, and the distance the pallet and escape-wheel holes must be from each other on an inch scale divided in 2500 parts. The second instrument has no other use than marking the distance found with the first on the watch, as it divides the inch also in exact 2500 parts. These instruments are further used with great advantage in pitching all other escapements as well as ordinary wheel depth.

J. Smith and Sons exhibit church-turret and house clocks, with all recent improvements.

Mr. W. G. Schoof exhibits a regulator for astronomical and other clocks. In this the pendulum is detached by applying the impulse to a cylindrical pallet tapped on to the *bottom part of the pendulum-rod*, so as to be easily adjusted to the fork or lever which gives the impulse in the same manner as the balance receives it in the ordinary lever watch. The pallets, to the arbor of which the lever is fastened, embraces three teeth of the escape-wheel only, as in a watch, but differs from the watch-pallets in this way, that the dead faces form part of a circle so as to cause no recoil of the escape-wheel in unlocking, the lever being heavy enough to keep itself steady while the pendulum completes its vibration.

Amongst the exhibitors of novelties in the construction of horological instruments must be named Joseph Sewill, with his "keyless gold pocket chronometers" winding-up and setting hands from pendant.

A. Watkins exhibits his direct-action triangle time-keeper. According to the inventor it has many claims to attention. In the first place it is simpler, it having but thirty-one pieces of mechanism, whereas the old kind has sixty-three. It has a direct action of the motive power, and is equalized by a simply-constructed spring for the purpose. By this means the fuzee, its appurtenances and complications, amounting to fifteen pieces, are entirely dispensed with; for the fuzee, the best and only construction for the equalization of timekeepers, has by this new invention become useless. Secondly the curved solid plates, constructed so as to dispense with bolt joint and screws of every kind; they have no moveable parts, consequently are flatter and more elegant in appearance. The power is greater than in the ordinary watch, and they are less liable to disorder or breakage.

Mr. B. Marriott exhibits lever and verge watches.

The collection of horological instruments and tools exhibited by the Prescott Committee, are of great interest to all who are in any way connected with this interesting manufacture.

The application of electricity to the measurement of time has its representatives.

Mr. C. G. Gumpel's electric clock has several improvements. The oscillations of the pendulum are independent and free of any influence from the moving power (whether electricity or gravity). The pendulum is compensated. The rod, being white deal, is baked, and soaked in a mixture of beeswax, oil of turpentine, and linseed oil, and then French polished to prevent absorption of moisture. The compensation consists of a zinc tube (sheet zinc) resting on the adjusting nut at the bottom of the wood rod: on the top of the zinc tube rests the cast-iron bob by means of a plate screwed to the latter. The proportions are the following:—The acting weight suspended from the curved lever, for the purpose of uplifting the impulse arms, is 2½ drachms, exerting a pulling pressure (longitudinally) of about 1½ drachms at the point, where the arms hold the curved lever, so that *the actual force required to disengage the arms is a high fraction of a drachm* (the hooks of the curved lever and the pin in the impulse arms being hardened and polished cast steel). Hence the pendulum insures a correct timekeeper, equal (by even inferior workmanship) to the best astronomical clock. In the best-known electric clock, the pendulum makes a contact at each oscillation by bending a spring, which in itself, as the temperature varies, will influence the rate of the clock. Besides the manner in which the impulse is imparted to the pendulum in that clock is *not free from friction*, and tends to produce "wobbling," as the impulse, although parallel, is not in the same plane as that in which the pendulum oscillates. The contact-makers are formed of iron cups, containing mercury, into which dip pieces of copper with iron ends. The one enters the mercury before the other leaves, so that no spark from the direct current can oxidize the surfaces of the contact-makers, as both transmit the same current alternately; the left one to the magnet of the pendulum, the right one to the clock.

CLASS XVII.—SURGICAL INSTRUMENTS AND APPLIANCES.

Number of Exhibitors, 130.

SITUATION OF CLASS.—*This Class is situated in the Gallery of the North Court, immediately between Philosophical Instruments and Horology.*

The articles exhibited in this Class are of a character which do not admit of being described in a popular manner. There has been a very large amount of ingenuity expended in the production of instruments and appliances which are to afford relief to the sufferings of humanity. Feeling that it is not possible to notice all the things exhibited in such a manner as would prove satisfactory, either to the public or to the producers, the only method, that of rapid selection of type objects, is adopted.

Lawson, Buxton, and Co. exhibit a fine variety of surgical instruments of all kinds; these are really remarkable as a display of cutlery, and many of the instruments for the more delicate operations are fine examples of workmanship.

Dr. Arthur E. Sansom exhibits an instrument for the inhalation of chloroform. This is so constructed as to administer the vapour of chloroform gradually. A very small proportion is first given, and this is, step by step, increased; so that the patient becomes tolerant of the vapour which, in other instances, proves irritant and offensive. Moreover, by this instrument, the danger which has hitherto attended the use of chloroform is, in its greatest degree, obviated; for not only are measures taken for regulating the dose, but the entrance of air is so regulated that the chloroform itself can never be given in a dangerous proportion. The gradual (inverse) dilution is effected by secondary currents of atmospheric air, which can be turned on or off at pleasure.

W. A. Tompson exhibits a well-constructed inhaler, for applying caustic solutions in throat disease. It consists of a bellows and tubes. The fluid to be applied is conveyed to the nozzle, along which it passes to the gauze disc at its extremity; whence it is dispersed upon the diseased surfaces in a minutely-divided and misty spray; and thus passes through the opening of the glottis, during inspiration, without causing the slightest inconvenience to the patient.

The amadou plaster, exhibited by J. Weatherfield, has been highly recommended by Sir B. Brodie.

HOSPITAL AND SICK-ROOM APPLIANCES.

Dr. Arnott's water beds, exhibited by W. and F. Smith, are now well known, since they have been in use for many years, affording wonderful relief to the bedridden whenever they have been used. A patient on this bed has always as soft a support as a water-fowl has reposing on the water, thus escaping altogether the unequal pressures of other beds, which often, in protracted illness, cause restlessness, skin inflammation, and the ulcers called bed-sores, and through these, not unfrequently, death.

The Nightingale cradle is a cheap and useful arrangement, invented and exhibited by Mr. Thomas Dixon. The peculiarity of the Nightingale cradle consists in a simple arrangement, by means of which the stale sheet can be removed without distressing the patient. In many surgical cases it is of prime importance that the patient should be moved as little as possible. Some spinal complaints do well or ill in proportion as the patient is kept motionless or not; and in some medical cases it is a great advantage to be able to change the under sheet without disquieting or exhausting the patient.

Captain Russell is the inventor and exhibitor of improved hospital bed appliances, and an improved hospital stretcher, and some other appliances of much value to the afflicted, which he desires to see introduced, and he generously gives the public the advantage of his plans.

TRUSSES AND BELTS.

Mr. M. J. Lindsey has a large display of trusses for every form of hernia, and for every age.

Longdon's elastic supports for the abdomen and legs enjoy a high reputation.

John Reynolds has some improved bandages for navel or ventral hernia.

J. Hoy proposes great relief for abdominal hernia, by his truss, the elasticity of which is said to be so free as to yield to the ordinary action of breathing.

Wm. Blackwell has an "air-padded truss."

Charles Rogers has an ingeniously constructed either-side double-lever truss.

W. Coles and Co. are well known for the manufacture of these useful appliances, of which they exhibit many specimens.

Mrs. Sykes exhibits a newly-invented abdominal belt, for preserving the figure, and to supersede the calico bandage usually worn during the accouchement.

Mr. Arkbuckle has brought together several very excellent examples of the manufacture of trusses, showing a correct knowledge of the mechanical principles involved.

ARTIFICIAL LIMBS, EYES, ETC.

Mr. Grossmith exhibits artificial eyes, legs, arms, hands, fingers, noses, &c. His novelties, prepared for this exhibition, are stated to be improvements and further modifications of the principles which gained for him the prize medal of the previous London and Paris Exhibitions.

In the first-class artificial legs, he claims to have acquired greater safety and durability, and easier action than has hitherto been obtained in limbs of very light weight; and in those suitable to the working classes, a simplicity of construction and cheapness in price, which will render them accessible to all. The long standing of Mr. Grossmith's house (upwards of a century) warrants the expectation of genuine superiority in his productions.

John Reynolds is an exhibitor of an artificial leg, having the knee and lower part of the leg united by means of steel springs *only*, which will lessen weight and friction.

F. Sillis has an artificial leg with additional stop to preserve the foot from splitting when the wearer is sitting; and an artificial arm with improved joint. Charles Thring has a good artificial leg, and a well-made arm sling. Mr. Welton's jointed pin leg has been approved by many eminent surgeons.

Cheland and Hill have some novelties in their artificial leg and hand.

DENTISTRY.

Artificial teeth and dental appliances have many exhibitors. The teeth are of various kinds, each particular manufacture having its especial recommendation. They are, amongst other things, prepared in "vulcanite." This compound, described in Volume I. page 164, giving, it is stated, many of the conditions which belong to the natural appendage. Mr. J. Maurice exhibits his patent application of vulcanized india-rubber as a basis or gum for artificial teeth and as a covering for fastenings. Then we find teeth with "air cells and soft gums."

T. Lemale and Co. have an excellent collection of artificial teeth. Messrs. Mosely have a gum-coloured enamelled base for the artificial teeth.

The improvements which have been made in dental instruments are great, and some excellent ones are exhibited. Some of the new forceps and elevators are exceedingly well adapted for the uses intended—Dr. Gordon's especially. The forceps exhibited by J. C. Smith are well made by F. Collins.

Hudson has an improved tooth punch, for extracting stumps from the gums with celerity and ease, without injuring the lingual arteries or muscles of the mouth. G. F. Williams shows several improvements in mechanical dentistry, and contrivances for repairing injuries arising from gun-shot wounds in the mouth, and a substitute for the loss occasioned by disease of the right half of the upper maxilla.

SUNDRIES.

Mr. Thomas Weedon exhibits some excellent instruments for the use of microscopic observers. They consist of various small knives, scissors, and forceps of varied forms, needle and object holders, as also instruments for animal preserving; "Valentin," and other section knives for morbid anatomy, together with injecting syringes and pipes for large and minute injections.

Mr. O'Connell's apparatus for giving nourishment to infants promises to prove "a real blessing to mothers." He has recently applied the same principle in a suitable form for the artificial rearing of lambs and other young animals.

Messrs. Savory and Moore are exhibitors of several useful instruments, &c. Attention should be directed especially to the improved medical panniers, for the use of the army, which are designed to convey all the appliances, both medical and surgical, that may be required during a march. Within the compass of two panniers of even less than ordinary size, and below the regulation weight, are contained, on the one side, some thirty different drugs, with all the required accessories of scales, weights, &c., each so accessible as to be obtained in a moment; medical comforts for the sick and wounded, such as brandy, concentrated beef tea, arrowroot, &c.; a lamp with reflector and such adjustment as enables it to be used in warming a small quantity of food. In the other pannier may be found the case of operating instruments, twenty tourniquets of different kinds for field use, fifty bandages, plasters, sheeting, splints, and everything to hand.

The two panniers are so constructed that they can be made to form a very good and firm operating table, by placing them on the ground, throwing open the lids, and securing them in the required position. The advantage of this arrangement, when the surgeon is in the open field, far from houses, is obviously very great.

To protect the contents against the rough usage incidental to active service, these panniers are covered with the strongest horse-hide, tanned with the hair on. They are consequently perfectly water-proof, and are capable of withstanding any fair amount of hard wear and tear. As a proof of this it may be stated that, after passing through all the vicissitudes of the campaign in China, some of these were returned uninjured into the military stores.

ELECTRICAL APPLIANCES.

Messrs. Welton and Monckton exhibit a "magnetic chair or sofa for the cure of disease without shock to the nerves." This is an iron chair, and the patient, being seated in it, is exposed to the supposed magnetic influence of a powerful electro-magnet. It is greatly to be regretted that, in entire ignorance of the known laws which regulate any form of magnetic force, it should be presumptuously stated that magnetic influence could thus be conveyed to the living system; or that, being conveyed, it could exert any power of controlling those organic changes upon which diseased action depends.

CLASS XXVIII.—PAPER, STATIONERY, PRINTING, AND BOOKBINDING.

Number of Exhibitors, 242.

SITUATION OF CLASS.— *Gallery, North Court.*

If the stairs on the North-west corner of the Eastern Dome be ascended, this Class is reached. India joins it on the Eastern side, and Horology on the Western.

SUB-CLASS A.—PAPER, CARD, AND MILL-BOARD.

In writing on the article paper, we feel much inclined to enter on a disquisition wide of our present mark; so much has that article had to do with the civilization and elevation of the human race, from the times of the scribes to that of the steam-press, from the days of papyrus and vellum to that of cotton, straw, and other vegetable fibres.

Entering the paper court, from that of horology, in the corner on the left may be seen the collection of Mr. T. ROUTLEDGE (5087), who shows raw material, *half stuff*, and paper made from *Esparto-fibre*, a Spanish grass, giving a tough and suitable material, admirably adapted to the purpose of the paper-maker, who may live to be independent of cotton rags; an article that at present has not risen in price, as was expected, with the abolition of duty and vastly increased demand for paper; cotton rags, though governed by the laws of demand, are for their supply restricted to the waste produce of populations, many of them far from literary, semi-civilized, and wide of the European market, which imports rags from India, China, and Japan: specimens are exhibited by Mr. SAUNDERS in the court: the produce of worn-out garments being limited, the want has to be supplied by fibre-giving plants, hundreds of which might be named; but for rarity, difficulty of transport, culture, or some other cause, become practically useless.

Esparto-fibre, from which Mr. Routledge's paper is made, is not prepared, as straw is, by cutting; but the pulp is produced by boiling the plant as torn from its native earth. Esparto-fibre is a new substance, being brought to this country as ballast from the coast of Spain, and may possibly hold its place should it not become too dear or costly to import.

Paper is producible from an infinity of materials—even deal shavings have been made into paper. In paper from *hop-bine*, Mr. BARLING (5081) exhibits the utilization of a vegetable waste, less costly than *straw*—a substance gradually working its way into the paper-mills of England. M. Mellier exhibited in 1851 a small sample—the produce of a French factory—though he did not patent his process until 1852. Straw, as a material from which paper may be made, has long been known, though not practically used, until within the last few years, the remission of stamp and paper duties greatly aiding its manufacture, which is perhaps as clearly demonstrated in the case of Messrs. BURGESS and WARD (5082), as is possible: they not only showing the process, from the chopped *oat straw* to the pulp, but the refuse, and results in the form of prints and publications, cheap news, and other papers. *Oat straw* gives a good fibre, but wheat straw is the ordinary staple: both are used alike, to the benefit of farmers in certain districts who send their produce to the boiling vat instead of to the lair or straw yard; and it is a question whether it might not pay to cut straw green several times a year for the paper-maker alone, before bearing seed, when it dies. *Barley straw* will not produce pulp, though *Indian corn* will; indeed the catalogue of the Austrian department is printed upon paper made from that plant. At present the alkali in which the fibre is boiled is lost, and the consumption of coal about ton for ton of paper. In *straw paper* we are making great progress, the material having both beauties and defects (one of its greatest drawbacks being a crispness in handling, and liability to injury in folding), as may be seen by the display of Messrs. TOWNSEND, HOOK, and Co. (5090), who have produced webs of much excellence, and doubtless will do more to overcome the peculiarity of texture, without raising its cost to that of paper from rag. *Straw* as a substance for *brown paper* and good *mill-boards*, the display of Mr. TOWLE (5094), of Oxford, will show; as material for pipes both for hot and cold water, and roof covering, it is admirable; and we are informed that pipes of paper, well pitched, show little if any signs of decay after having been years under ground: that mill-board is less combustible than wood, also we believe, having seen a roof burnt until it reached the paper, where the fire was arrested; as a substance for carriage panels, boats, houses, and ships, it has uses now unknown. We have but one contributor of Buckinghamshire boards; Mr. MORLEY sends an article of sterling worth, though not novel: and the same may be said of the brown papers contributed by Mr. GREER of Cork. Mr. SZERELMEY (5089)—who exhibits paper pipes for gas and water, which are producible at a cheap rate, indurated with a compound called by him *Arabian Zopissa*, the composition of which is unknown—also is testing its powers for artillery purposes; he exhibits rocket cases, pails, &c., and is, we are informed, constructing a three-pounder cannon of the like material. This exhibitor composes his articles of common brown paper, and reports them to be stronger than oak, waterproof, and 50 per cent. cheaper than wood or iron; he also says they are not affected by water or acids, will not burst with frost, and resist great pressure. Of the papers of Messrs. COWAN (5125), little need be said, so widely are they, and Mr. SAUNDERS (5088), known for first-class writing and other sorts, in which we greatly excel foreign countries. The tenacity of paper as exhibited by the former shows their parchment royal machine-made paper, 6 inches by 19, weighing one-tenth of an ounce sustaining a weight of 200 lbs.; the latter gentleman's water-marks and special collection being fine; indeed the pictorial effects produced in the papers when seen in a good light are not unlike the porcelain pictures so popular in the windows of villa residences. As a prevention to forgery, their devices and marks in paper are of great use. We need not remind any one of the peculiar crispness and marks so tangible and so visible in the genuine Bank of England note.

Before leaving this court, it would be well to note the pottery tissues of Mr. LAMB (5085), that those who eat may have food for reflection whilst so doing, by pondering upon the process by which copper-plates are transferred to china. "*Pottery tissue*" is a strong paper made from old rope, being manufactured alone to carry the ink of the engraving from the copper-plate to the biscuit china, before that material is coated with fused glass, in the kilns of Staffordshire and Worcestershire.

STATIONERY.—SUB-CLASS B.

From paper we naturally turn to *Stationery* and the imitation of Nature in one of her lovliest forms, that of *flowers*, so daintily imitated in paper by the fair hands of Mesdames STODART, WETHERFIELD and HIGGINSON; and like bees in this grand hive, from flowers to wax,—and impressions in waxworks holding a debatable ground between the fine and useful arts, partaking largely of the former whilst bound to the latter. The devices of ORTNER and HOULE (5163) are to be commended, and particularly the seals of WYON (5193), including as they do the *Great Seal of England*, that jealously-guarded die, so potent when affixed to the legal documents of this Empire; also the Great Seals of Scotland, Ireland, Duchy of Cornwall, &c.

Of *Stationery*, as it ministers to trade and commerce, the show in ledgers is respectable. Of stationery, as it ministers to the frivolities of both sexes, the show of valentines is instructive. Of stationery, as it ministers to the passion for chance, the show of playing cards is a warning.

The machines and appliances connected with the administration of trade and commerce are important; JONES and CAUSTON (5148), ROWSELL (5170), MEAD and POWELL (5158), and WARD of *Belfast* (5191), exhibiting the best general stationery. The Irish house last-named being perhaps the first for quality as a whole. LETTS and SON (5151), *diaries;* PERRY (5165), *pens* and *elastic bands;* JOHNSON and ROWE (5147), *pocket-books* and *portmonnaies;* WEDGWOOD (5189), *manifold writers;* MORDAN (5161), and WEBSTER (5183). Inkstands; *tracing papers*, and *cloth*, are here also. *Marbled Papers*, CORFIELD and SON (5124), showing a good assortment of kinds for which we are famous. This process of colouring paper, or rather fixing colours upon paper, is as old, if not older, than printing, and is done in the following manner: colours being rendered buoyant by mixing with oil, are floated upon size-water in troughs, from the surface of which they are lifted upon sheets of paper as shown. Of *silver* and *foil papers* the show is also good. Messrs. McGLASHAN (5154), and BOSQUET (5110), exhibiting their brilliant sheens, produced in almost every case by the covering of silver with iridescent hues—such material being used for stage effects, paper boxes, and toys, as shown in the tasteful cardboard caskets, plum and ribbon boxes of BAUERRICHTER (5106), JOHNS (5146), and BENNETT (5108)—a branch of light wares hitherto manufactured in France: from boxes we pass on to the *cardboard* of TURNBULL (5091), and WOOLLEY (5092), both of excellent manufacture. In this court will be found *show-cards* and framed *labels*, by some called "advertising mediums," but, in truth, eye-traps to catch the unwary, by ravishing one of the senses—opening the gate to the mind through the eye—taking the brain by storm.

Before parting with stationery a glance at the nicely arranged frame of *playing-cards* and miniature stationery of GOODALL (5134), will repay the curious, showing how many colours there are in the tabard of a jack of hearts, or the robe of a queen of trumps. To the right of this will be found card backs and linen bands, designed by OWEN JONES (5191), for Messrs. De La Rue, which are very effective.

In *Fancy Stationery*, *lace papers* and *valentines* are paramount, and persons unacquainted with the trade can form but little idea of the vast sums expended upon decorating paper to be offered once a year at the shrine of Cupid and Puck; the commerce in these things is enormous—prices ranging from one penny to many pounds. *Pencils,* not made of pure Cumberland plumbago, next claim our attention; the mine of that county having been exhausted years ago, pencils are now made of inferior ore, that is prepared, pressed, and worked up in divers ingenious ways. Many makers (BROOKMAN and LANGDON, 5113), BANKS, and WOLFF, show blocks of plumbago or graphite, improperly called black-lead, and lead from different continental mines, East India, Spain, Ceylon, &c., all of which, unlike the pure lead of Cumberland, require refining and preparing before use. See Class II., vol. i. Solid ink pencils are also shown by more than one maker—an indelible substance—filling a space between a pen and pencil. For printing inks Messrs. SMITH (5282), and PARSONS (5271), show both materials and results. Writing and marking inks are also represented.

SUB-CLASS C.—PLATE, LETTER-PRESS, AND OTHER MODES OF PRINTING.

Upon arriving at the top of the stairs (next India and near the Eastern Dome), we find in the *printing* court, types, appliances, and impressions, too numerous to mention, but giving a fair idea of one of the mightiest engines of modern times, *The Press,* "the fourth estate." We have not the great cylinders that roll through the night, impelled by the giant power of steam (these may be viewed in the Machinery Annex), or a notion of the hundreds of tons of paper to be disseminated, and on their way to the four quarters of the globe before dawn of day; but we *have* the units that compose the mass, the grains of sand that make the mountain; the *types* that, combined, compose a "*Times,*" a "*Telegraph,*" a "*London Directory,*" or an "*Official Catalogue,*" the first named being shown as a specimen by MILLER and RICHARD (5265), the latter by Mr. CASLON (5217).

FIGGINS (5232), and BESLEY (5208), also show good, well-finished, solid type, wisely eschewing the ornamental, in which we are not great; decorative printing on the Continent being better understood—that is to say, the ornaments are better in detail, and the workmen more apt in their application, as may be seen in the pattern-books from the imperial offices of Vienna and Paris. Art and industry ought to go hand in hand, and in no department is it more needed than in that of printing.

BONNEWELL (5213) has a large show of appliances for the printing-office, near which may be found *electrotypers* (MOREL 5266), *stereotypers* (MCPHERSON, 5261), *wood-block* preparers (SCOTT, 5277), *wood-engravers* (LEIGHTON, 5255), *copper* and *steel plate* preparers (HUGHES and KIMBER, 5247), *stamp-cutters* (BERRI), *bookbinders' tool-engravers* (DE LACY, 5225), and others.

Mr. MACKENZIE (5259) shows a well-printed *Bible* composed by machinery expressly for the Exhibition; and Miss FAITHFULL (5230), a copy of "*the Victoria Regia*," remarkable as having been produced wholly at her own press, and by women.

Of new inventions connected with printing may be mentioned Mr. W. J. LINTON'S (5256) "*kerographic*" process, a novel method, not unlike, in its results, to glyphography, whereby the aid of the engraver may be dispensed with—a long-sought-for desideratum, but one which, from some unknown cause, has hitherto failed in connection with surface printing.

"*Nature-printing*," as practised by the late HENRY BRADBURY (5214*), was most successful in the self-delineation of different natural objects, as ferns, feathers, lace, sea-weeds, leaves of plants, &c.; and as such fulfilled its mission, and probably paved the way for the efforts of Mr. GEORGE WALLIS (5294), to obtain pictorial effects by a process of his own somewhat akin. The new art of "*autotypography*" is a most ingenious attempt to supersede the incised plate of the copper-plate engraver, by making the drawing, as it were, engrave itself almost instantaneously, even to the reproduction of delicate washes of Indian ink, somewhat as mezzotint renders very faithfully the spirit and touch of the original.

Amongst the reproductions we must not omit to mention Tyndale's first Testament in English, reproduced by Francis Fry, of Bristol, a reproduction of the only known copy of the first edition of Tyndale's New Testament, perhaps the most interesting book in our language, well worth the time, money, and pains employed in its execution. It contains 692 pages of close small type, is a faithful representation of the original, and will be valued not only as a version, but as showing the state of the English language, the style of the printing, the orthography (which is very irregular), the punctuation, the divisions of the words at the ends of lines (even to a letter), and the contractions used. *It has been made by tracing on transfer paper*, placing this on lithographic stones, and then printing it in the usual way: a method evidently calculated to insure the closest possible correspondence with the original. So large a work traced with a pen, and printed by lithography, we believe has never been before attempted.

To prove the correctness of the work, the exhibitor has compared a proof of every page, folding it so as to place each line parallel with, and close to, the same line in the original, so that, by comparing the line we could easily see that it was correct. Tyndale alludes, in his address "To the Reder," to "the rudness of the worke." This may refer to errors in the printing; and these the reader will see, as no alterations have been made.

The paper on which this Testament is printed has been expressly manufactured to imitate the colour and appearance of the original. It is *hand-made*, the fine and cross wires being placed in the paper-maker's mould so as to produce the same wire marks as appear in the paper used by Schoeffer.

J. H. JEWELL (5248) exhibits specimens of music-engraving and printing. We would direct attention to the musical notation: the notes used in the work being sharply cut, and equally placed upon the lines and in the spaces. The adoption of the thick ledger-lines above and below the stave is also to be considered an improvement.

Mrs. **Lavinia Jones** exhibits her Albion press in the Process Court, adjoining Messrs. Day and Sons, lithographers to Her Majesty. An Albion printing-press—and truly it is an Albion, though in miniature—well constructed, and so complete and finished in all its parts, that we have no hesitation in classing it among the best machinery of its kind.

The objects are to supply the library of the nobleman, the college of the student, the merchant's office, or the schoolmaster's rooms, with a most available addition to his educational pursuits.

But this miniature printing-press has still another hope, and addresses itself to ladies, who, with a neatly-fitted cabinet pedestal, could, with a little instruction, apply, in their leisure hours, the ingenuity and perseverance shown in the complicated and varied works they produce: could their minds be but once directed to a resource of this kind, the endless thought and elegant accomplishment—so easily done with so perfect an instrument as this—would soon become a charm among their private circles, and also would be likely to branch forth into village helps, or world-wide beautiful pages.

This miniature press is the property of Mrs. Lavinia Jones, of Bradford-on-Avon, and has a collection of specimen sheets in most of the spoken Continental and Oriental languages in their own character,—thus making its appeal as an applicant for universal attention.

Of *photographic results* the class has small evidence, though Messrs. J. and J. **Leighton** (5318), show an old print reproduced, being reduced from a folio, and printed from a plate incised by the action of light alone without the aid of an engraver. Mr. **Clay** (5301) also exhibits, among his choice examples of *block-printings*, an engraving on wood from Flaxman's "Deliver us from evil," that has been executed from a photograph upon wood unaided by the draughtsman; it was cut by T. Bolton from a negative of Mr. J. Leighton's;

it is executed in perpendicular lines, all the forms being rendered by the graduation of the single stroke alone.

In the frame of the ELECTRO-BLOCK COMPANY (5228) are specimens of *enlarged and reduced engravings*, mostly transferred to stone by the expansive properties of india-rubber, giving a bold but faithful fac-simile of the original, that has been found useful in several ways, from the enlarging of wood engravings upon canvas so as to form the foundation for oil pictures, as Mr. John Leech's sketches from "*Punch*" will prove, to the placards and posters exhibited here.

In the exhibition of *typography* may be included the Bibles produced by Her Majesty's Printers, Messrs. EYRE and SPOTTISWOODE (3229); the rare show of Polyglots from Mr. BAGSTER (5203); and the specimens of types exhibited by Mr. WATTS (5295), where a line of Scripture is repeated in all the different dialects and characters known: this exhibition also shows tangible printing, or rather embossing, for the blind. In this class—as specimens of printing, or rather "getting up"—exhibit the great *publishing* houses of London, including LONGMAN (5257), and MURRAY (5269), so celebrated for their choice decorative books. Of printers and publishers who combine the two, Messrs. BRADBURY and EVANS (5214*), and W. and R. CHAMBERS (5217*), are the largest.

As a link between printing and engraving, may be taken the display of notes exhibited by the BANK OF ENGLAND (5204), whose *Promises to pay*, both English and Indian, give an ideal wealth to the department. The notes shown are surface-printed, and greatly resemble the old copper-plate, from which the script is in fact copied. The note is now wholly the production of machinery—even to the paging, numbering, and signature—owing at least half its security to the paper of peculiar manufacture on which it is printed—water mark, rough edges, &c. Fifteen hundred impressions, or 3000 notes per hour, are produced at each machine; of the Indian notes, 1500 impressions, or 6000 per hour, at each large machine.

Messrs. Bradbury and Wilkinson (5214) also exhibit a fine display of *notes* and documents of the highest order of workmanship in art and execution, both by machinery and hand; the engine-turning being subservient in most cases to the general design—a thing difficult to render, by the Guilloche engine refusing, as most machines do, to be governed by the laws of the beautiful. The notes printed in various colours, blues, yellows, and greens, as a check to forgery, by photography, are worthy of observation, as also the copper plates covered with steel and nickel, very enduring surfaces, hard metals, capable of being washed away and renewed at pleasure without detriment to the fine engraving.

Copper and steel plate printing are represented by McQueen Bros. (5262), whose work will be appreciated when it is known how much the artist owes to the care of the printer for the quality of his impression. From *plate printing*, a long operation by hand, to chromatic printing by steam, there is a wide step, both in effect and price, the former finding its way alone to the mansions of the wealthy, the latter to the cottages of the humble poor.

Chromatic printing in all styles has of late years made great progress; in fact it may be said to have sprung into existence since the last International Show of 1851, though in principle old. The small subjects of Mr. Dickes (5226) are to be commended for many qualities; whilst those produced by Messrs Leighton Bros. (5254) are as widely known as the form in which they have appeared, being particularly rich in colour: the fruit pieces, especially, are most carefully rendered. When it is remembered that these productions are the result of most rapid printing by steam power, the wonder is that they are so excellent, being far more durable than water-colour drawings—in fact, oil-colour pictures on paper, purchasable for a few pence, of which these are *bonâ-fide* specimens, some having been worked 250,000 times.

In *Lithography* the show is good and attractive. Little could Senefelder have dreamed, when he accidentally discovered the art by writing, upon porous stone, a washing bill for his mother, that the same principle (the non-affinity of grease for water) would or could be developed into so perfect an art, that even our first water-colour painters do not disdain to sign the products of the chromatic press as faithful transcripts of their works.

For *Art-Lithography*, Messrs. VINCENT BROOKS (5216), DAY (5224), and HANHART (5243), are pre-eminent; whilst for the lithography of commerce MACLURE (5260), and STANDIDGE (5286), have great resources at command. In the race between the three leading lithographers all appear pretty equal, Mr. DAY depending greatly upon his royal portraits in black and white, aided by the fine chromo-lithographic works that have issued from his press within the last few years; Hanhart's are particularly strong in landscape, still-life, fruit, and birds' nests, likewise in portraits of various members of the Royal Family (of whom several of them are the private property); whilst BROOKS (5216), perhaps, would bear the palm for figures: copies of studies by Mulready in chalk, dashing drawings by Gilbert, &c. ROWNEY (5275), also, has some nice renderings in all styles, both landscape and figure.

Oil-colour printing, by GEORGE BAXTER, is also exhibited. The beauty of this process is the diversity of colouring, with so judicious a blending of light and shade, and the almost microscopic detail brought to bear on the smallest miniature of the collection, and producing the fac-similes of the original pictures.

The great advantage of this beautiful process over other inventions, is the rapidity with which the colours are printed: as many as 500,000 have been struck off of one subject, the last produced being equal to the first. The process is remarkable for the fine finish, truthfulness of delineation, minuteness of illustration, and beauty of colouring.

Professor WESTWOOD exhibits a folio volume, containing fac-similes of Anglo-Saxon and Irish manuscripts, bound in wood covers, carved with designs selected from the ornamental patterns with which the manuscripts are illuminated; also with casts of Anglo-Saxon and Irish metal-work, and imitation gems in the style suggested by the ancient Irish Cumdachs, the whole designed by the exhibitor.

SUB-CLASS D.—BOOKBINDING.

With a notice of the remarkable show of BRITISH BOOKBINDING, exhibited in Class XXVIII., our list will close: it is very good, and vastly better than anything got together heretofore; perhaps a little too much pervaded with notions gleaned from the old conventional patterns and modern French, but withal containing many good designs, well executed.

In *Bookbinding* we are apt to err on the side of solidity and strength, as much as our foreign neighbours, the French, aim at lightness and elegance—something no doubt being due to the greater weight of our paper, which is thicker and harder than theirs, requiring heavier covers. Each country, in its manufacturing arts, ought to have a style, peculiar to itself, growing out of the wants and demands of the people, who never can become great by literally copying any manner, however good in the abstract.

In the show of family Bibles, by Messrs. EYRE and SPOTTISWOODE (5229), these gentlemen have, with their excellent work, combined a rather heavy style of ornamentation, that, by contrast, causes the works exhibited by Messrs. BAGSTER (5203) to look somewhat feeble and delicate, which is not the case, their editions of the Holy Scriptures, in all languages, being well printed and bound.

In both bookbinding and printing, we are prone, with the fondness of antiquaries, to look back, not alone in treasuring the objects of the past, but to find pleasure in imitating them. In nothing, perhaps, are we so biased as in our bookbinders' patterns (or styles), that we have gone on imitating, with more or less success, for centuries. Art progress, and not imitation, ought to be the aim of every producer—not a painstaking waste or expenditure of time alone, but a judicious placing of parts—simplicity without baldness, and richness without waste.

We are aware that the "extra" binder has great difficulties to contend with in competing against the superior design expended on publishers' cloth books, where they pay an artist many guineas for a drawing—hence the vast progress made in that department during the last decade.

In Mr. BEDFORD's (5310) excellent display are many first-rate specimens of workmanship, the place of honour being given to a work by Mr. Shaw, F.S.A., and bound after his own design—a fine sample of tooling upon morocco, rich, original, and in good keeping, the leather being visible to a greater extent than is usual with the works of this binder, who is apt to fall into an infinity of dots and sprigs (cloth of gold patterns), only remarkable for the quantity of time buried in them. This is the case with several copies of Rogers' "*Italy* and *Poems*," which are imitations of the French work, as are many others; the "*Poets' Pleasaunce*," in yellow and green, is nice; also a "*Dante*," in rich Italian, brown morocco, tooled over with dots, making the forms tell out. Admirable in taste is the tooling upon the fine olive morocco folio, "*Poliphili Hypnerotoma Chia*," 1467, one of the period. A "*Vicar of Wakefield*," in blue morocco, inlaid, is also good: though we cannot agree with the placing a Louis Quinze pattern upon such a volume as "*Turner's Views of England and Wales*," or in fact repeating the debased ornament of that period upon any work not of the eighteenth century.

The specimens of calf, with sprinkled sides in panes, and also the calf gilded volumes, are most excellent, not alone as books bearing certain good English work upon them, but rich as they are strong, elegant, and useful.

Mr. ZAEHNSDORF (5330), also, has a show of perhaps the most perfect work to be found on the British side, so minute, sharp, and clear, as to make one think them the production of Paris rather than London. Indeed we believe the tools to be French, and quite new: his *tour de force* being a copy of Doré's "*Dante*," a marvel of work combined with good design, though we must say we would rather the expenditure of work within the boards of this volume had been bestowed upon the outside of some other book, so excellent is it. In the "*Sakoontala*," the work is good, but design very inferior; not so "*The Poets of the Nineteenth Century*," a beautiful book in morocco, with an effective *grolier* pattern; or "*Etude sur S. Champier*," also good, and in chaste taste: as to the blind-tooling both upon calf and morocco, it is as clear and precise as possible.

Having arrived at perfection of workmanship, perhaps it would be well to pause and consider strength—a material element in old books—quite lost sight of by modern binders in aiming at precision, delicacy, and finish: leather is pared so very thin until it is like paper in substance, and about as durable. The great aim of British binding ought to be a middle course; durability with finish, beauty of material with design.

Of the work of Mr. Chatelin (5312), a French bookbinder settled in London, we have the same sharp delicate finish, with great care bestowed upon the insides of the boards, some of which, and particularly the tooling upon silk, are very choice, though we cannot quite approve of anything but the most conventional of figures being delineated upon a book; in the figure on the side of "*Le bel Inconnu*," difficulties have been overcome, but not vanquished. Rammage of Edinburgh (5323) exhibits some good examples of binding; his copy of "*Palæographia Sacra Pictoria*" having a choice grolier of old design outside, excellently worked: the cross inside is not so happy. Raines (5322), shows good strong work, but no refinement in the tooling; perhaps the "*Campaign of Russia*," bound in russia, is the best. Of Wright's binding, his purple morocco grolier "*Regum Francorum Imagines*" is the best. Hayday does not exhibit, though the Bible, exposed by Mr. Mackenzie (5259) as a specimen of printing, is bound by that bookbinder.

Holloway shows a "*Lockhart's Ballads*" in green morocco, and "*Gruner's Fresco Decoration in Italy,*" both nicely tooled. Some very creditable specimens of provincial workmanship and novel designs are supplied by BEMROSE of Derby. The great feature of the bookbinding court is the extensive display of MESSRS. J. and J. LEIGHTON (5318), whose works in 1851 excited such universal attention, both for novelty and workmanship—these gentlemen having a way and style of their own, perhaps sometimes a little whimsical, but always original and quaint. For variety, choice of colour, and material, they stand alone; from their bold hand-tooled and illuminated Russia side in the centre of their display, to the duodecimo all gold and studs, there is a wide range. The red-morocco *Bible* with illuminated edge is handsome, the rose, shamrock, and thistle tooling effective, as is also a rare folio copy of "*Cat's*" works with diamond side; the Doré's "*Dante,*" illuminated on black morocco, is somewhat heavy, but very Venetian in aspect, and bold. All the bindings of these gentlemen at least seem to have regard to the contents of the covers themselves, nothing being left to chance, as is mostly the case, when books of ballads find the same treatment as Bibles; devotion and poetry, arts and sciences, the same livery. The tricolour "*Napoleon*" (a replica of one shown in 1851) is very good, also the many fine Spanish leather bindings, a material apparently imported by this firm alone. Some of the simple band patterns are most effective; a copy of "*Burnet on Painting,*" in line, is very good; also "*Tennyson,*" "*Moore*" (shamrock and harp); and a copy of the "*Lyra Germanica,*" a vesica pattern, enclosing a passion-flower cross and types of the Evangelists.

Many of the drawings upon Messrs. J. and J. Leighton's works are very chaste, as also their collection of book-plates, restorations of missing pages, split paper, &c. With another first-class bookbinder we must close this list, preserving a place for the large *Publishers' binders.*

Mr. RIVIERE (5325), though last, is not least, especially in his patterns, the "*Lockhart's Ballads,*" and "*Cent Fables,*" being good *groliers*; and an *Offices,* inlaid in red on blue, particularly nice; also a folio *Prayer*, in line on morocco, though perhaps a little straggling; a tree-marbled calf book, shown in this case, is good and refreshing, such modes becoming rare.

On either side of the large case in the centre, over the reprint of the first edition of *Shakespeare* (5212), and *Tyndale's Black-letter Bible* (5233*), will be found the substance that has made the greatest revolution in book-binding in the present day, namely, prepared calico of all hues and surfaces. LAW (5150), and WILSON (5187). Cloth, or rather black canvas of a coarse description, has been used for centuries, but it was not until about 1826 the red glazed calico was adopted by Mr. Pickering for his miniature classics; they appeared in that material (instead of paper) with a neat printed label. About 1830, a step was made by embossing the cloth prior to placing the cover upon the boards, imprinting the title in gold; one of the first books so done being Mr Murray's 12mo "*Byron*," from which may be traced the progress of a national industry, in which we are almost alone, and a year or two ago had no competitors.

Messrs. LEIGHTON, SON, and HODGE (5319), are the largest exhibitors of publishers' bindings, which differ as much from extra leather work as is possible, both in design and materials; the one created for the exclusive use of an individual, the other for the many, thousands of impressions being needed to repay the cost of the dies alone. To this branch of British trade we may point with pleasure, as one that has been raised from nothing to a world-wide celebrity, our "*livres de luxe*," in "*toile-Anglaise*," going everywhere where English is read or art appreciated—a result greatly due to the designs of Mr. Owen Jones and "Luke Limner," the influence of whose works are to be found in many parts of the court.

For clearness of execution and beauty of design, nothing can compare with cloth stamps, when they are not debased into the semblance of plum-boxes by the union of tinsel and paint. Bookbinding now has the aid of steam, many of the blocks exhibited having been struck by that power at an astonishingly quick rate, a few days alone sufficing for an edition of many thousands, which, where it assumes the bulk of the "*London Directory*" is something enormous; the chief object to remark in this book is the admirable index edge, the invention of Mr. J. Leighton, that has been so profitable to the proprietors, though not patented.

Of the display of Mr. WESTLEY (5328), the former remarks will apply, only that he combines with his show many excellent specimens of extra bindings, both solid and good.

Mr. BONE (5311) also shows blocking in all its varied forms and materials, both in covers and the volumes also.

As a summary of the progress made in this class during the last ten years, may be noted the creation of a branch of paper manufacture, by the introduction of new fibres and the abolition of stamp and paper duties; the aids given to typography by the electrotype and photography; the advance in chromatic printing; and perfection of design in bookbinding; each in itself a great step, but taken as a whole an immense stride.

CLASS XXIX.—EDUCATIONAL WORKS AND APPLIANCES.

Number of Exhibitors, 228.

SITUATION OF CLASS.—(*Central Tower*). *Access to this Court is gained by a staircase leading from the vestibule between the English and the Foreign portions of the great Picture Gallery.*

The idea of an exhibition of educational works and appliances was well deserving of the most serious attention. And every one must suppose it received that attention, when we learn that the organization of this department was confided to a Committee of Advice, which was composed of gentlemen representing all the principal educational institutions and movements of the day. The list is given in the Official Directory.

Exhibitors.—A. Albites (5361), J. W. Bean (5363), J. Betts (5367), A. and C. Black (5370), W. Blackwood and Sons (5371), J. Bouverie (5373), B. Bower (5374), British and Foreign Bible Society (5375), T. Crampton (5379), G. F. Cruchley (5380), P. Cuipers (5381), Christian Vernacular Educational Society (5377), H. G. Clarke and Co. (5378), Darton and Hodge (5383), W. Fife (5388), Gall and Inglis (5389), J. Gordon (5391), E. Gover (5392), Griffith and Farran (5393), A. Hall, Virtue, and Co. (5394), Hodson and Son (5395), J. Hogg and Sons (5396), Jarrold and Sons (5398), A. Jones (5399), Rev. C. W. Jones (5400), J. A. Knipe (5401), Longman, Green, Longman, and Roberts (5402), S. J. Mackie (5404), Macmillan and Co. (5405), G. W. Martin (5407), D. Nutt (5410), Oliver and Boyd (5412), Dean and Son (5385), G. Philip and Son, Proprietors of "Weekly Dispatch" (5416), Religious Tract Society (5417), W. Shean (5421), Smith and Son (5423), E. Stanford (5424), The Rev. N. Stephenson (5425), Sunday-School Union (5426), S. M. Thelwall (5427), F. Thimm (5428), G. Wallis (5430), E. P. Wilkins, M.D. (5435), J. Wyld (5436).

The scheme of an Educational Exhibition, which was drawn up by the superintendent, J. G. Fitch, Esq., M.A., and others, members of that Committee, was a much more extensive and comprehensive one than it has been found possible to realize in so limited a space. It was hoped that the Court would be an International one, but the Foreign Commissioners expressed a wish to keep the educational collection of each nation separate; and, therefore, the opportunities of comparing the books and appliances used in the schools of different parts of Europe with each other do not exist.

The space demanded by exhibitors in this Class amounted to nearly fifteen times the actual area at the disposal of the National Committee, and unusual difficulty was therefore experienced in reducing the applications, and in allotting the space in harmony with the original scheme.

Mr. Fitch, the zealous superintendent of this Class, has himself described the arrangement of it so clearly that his description is adopted. The following is the classification finally adopted:—A. Books, maps, and diagrams. B. Apparatus employed in teaching. C. Toys and games. D. Illustration of elementary science.

A few of the most noteworthy objects in each of these classes are here indicated.

A. Books, Maps, and Diagrams.

All the principal educational publishers have sent their latest school manuals and treatises to this Class, and an arrangement of the books has been made, by which it is easy for visitors to consult them. Teachers and managers of schools will find this permission a great advantage to them. One bay or recess is exclusively devoted to books on education; and the newest works issued by Messrs. Longman, Macmillan, Black, Gordon, Dr. Cornwell, Nelson, and many well-known educational publishers are displayed here.

The Christian Knowledge, the Religious Tract, the Christian Vernacular Education Society for India, and the British and Foreign Bible Society also exhibit their latest publications. Our readers will remember the question, just brought before the Commissioners by the Bible Society, in reference to the position of their deeply-interesting Case of specimen translations.

Of the maps, those of Messrs. Stanford, Nelson, and Wyld will attract much attention.

A very ingenious mode of projecting the maps of the two hemispheres, so as to exhibit the true globular character of the earth, and to correct the false impressions which children derive from seeing two flat circular pictures, is also exhibited by Mr. Abbatt.

The collection is especially rich in miscellaneous diagrams for educational purposes, and in contrivances, not only for instruction, but for making the walls of a school-room cheerful and picturesque. In this department Messrs. Darton and Hodge make the most conspicuous show, but Messrs. Griffith and Farran, Mr. Gordon, of Edinburgh, and the Religious Tract Society have made important contributions.

The globes of Messrs. Smith, and of Mr. Newton, and the inflated india-rubber globe of Messrs. Macintosh, are among, the most remarkable specimens of manufacture in this department; and Mr. Betts shows some portable globes in slate and other cheap materials, for school use.

B. EDUCATIONAL APPARATUS GENERALLY.

Exhibitors.—**T. Allman (5362), W. Bell (5364), Bell and Daldy (5365), Rev. E. L. Berthon (5366), T. B. Bishop (5369), Rev. H. D. Blanchard (5372), Cassell, Petter, and Galpin (5376), J. Curwen (5382), W. Easton (5386), P. Fletcher (5387), J. Gilbert (5390), E. Gover (5392), A. Hopper (5397), G. Lucas (5403), Mair and Co. (5406), Lieut. Morrison (5408), Newton and Son (5409), H. Oakey (5411), Parker, Son, and Bourne (5413), R. Potts (5415), J. Reynolds (5418), E. W. Salmon (5419), Dr. W. Scott (5420), Simpkin, Marshall and Co. (5422), J. Tilleard (5429), Walton and Maberly (5431), J. Watkins (5432), J. Wharton (5433), G. White (5434).**

One of the most remarkable features of this Exhibition is the interest which has been shown in it by all the great religious educational societies. The National Society, the

British and Foreign School Society, the Home and Colonial School Society, the Reformatory and Refuge Union, the two great Sunday-school Societies, and the Congregational Board, have each in its own way sought to illustrate the work which they are doing. Several of the collections which have thus been formed are of great interest and value. Thus the National, and the British and Foreign School Societies, severally display complete sets of the fittings, furniture, tabular lessons, books, apparatus, and pictures required in the equipment of elementary schools. The stall occupied by the former society contains a beautiful set of models in miniature of the most improved forms of desks, easels, and other school fittings. The British and Foreign School Society has adorned its very interesting department with a large drawing of its new Training College, recently erected at Stockwell, for 100 mistresses. Infant-schools have long been under the special care of the Home and Colonial School Society; and it is, therefore, fitting that in its department the beautiful and rational discipline of the *kinder-garten*, and all the newest contrivances for making very little children happy in school, should be well illustrated. The bay which contains these articles, contains also a large model of the buildings which the Committee consider desirable for infant-schools of the first class. It also includes the tablets and books of the Sunday-school Union, and a group of very ingenious puzzles and other educational appliances, by Messrs. Joseph, Myers, and Co.

The work of the reformatory and ragged-schools is illustrated by a novel and singular contrivance. A large portion of a counter is occupied by a model representing the career of a street urchin, who is rescued from vice and degradation, and conducted through the ragged-school or the reformatory, and a subsequent course of wholesome industrial training, until he becomes a prosperous colonist. The various features introduced into the model are described thus:—

At the left corner are destitute and criminal boys and girls begging, stealing, and fighting in the streets. In the front centre are groups at indoor employments in various institutions, learning in school, and working in industrial classes. On the right (outside the school) is one from each of the eight ragged-school shoeblack societies, and a cart of the Rag-collecting Brigade. The reformatory training-ship "Cornwall" is at the right corner. Over the river are inmates of country institutions drilling, mowing, digging; going to church; at a holiday treat, with a band under trees, fishing, feeding birds, sailing, playing cricket, and gymnastics. At the left (near the lighthouse) is a group of inmates educated and reformed, as honest men and women in various situations—soldier, volunteer, servant, tradesman, &c., while others are sailing off as colonists on board the departing ship "Emigrant."

Close to this series of tableaux, there is appropriately placed a model of the latest addition to the Philanthropic Farm School at Redhill. It is of a house built in memory of the late Mr. Samuel Gurney, which is adapted for the reception of fifty boys, and which forms, we believe, the fifth of the homes erected by the Society on their admirably-managed estate.

The adjacent bay is devoted to the illustration of the methods employed in teaching drawing and design; here the Science and Art Department exhibits a complete series exemplifying the course of instruction pursued in the Government Schools of Design. Messrs. Reeves, Rowney, Roberson, Newman, and Wolff contribute specimens of the materials employed in art education; while Mr. Croydon, and Mr. Brucciani, and Mr. Sharpe, of Dublin, have sent drawing models of a curious and novel character.

To the philanthropist, few features of the educational court will be more significant and attractive than the small recess devoted to the illustration of processes employed in teaching the blind. Every expedient and artifice for instructing the blind in reading, in writing, in arithmetic, in geography, and in the industrial arts will be found here. It is well known that the friends and supporters of various Blind Asylums differ respecting the best plan of teaching reading. By many it is believed that a phonetic system, free from the anomalies and difficulties of the ordinary alphabet, may be advantageously used in the case of those pupils who, having never seen a book, have nothing to unlearn, and are therefore free from all the embarrassments which the use of our orthography creates. It is especially interesting to study the several forms of the alphabet which have been devised for this purpose, and to observe that experience seems to have led to the adoption of the ordinary Roman characters, and to the assimilation of raised type for the blind to the familiar character employed in other books. Some embossed maps and pictures, writing-and-ciphering frames, and two large globes in relief, will be found worthy of special notice by all those who care to investigate the ingenious contrivances now in use in our Blind Asylums. Viscount Cranbourne and Mr. Edmund Johnson have not only contributed to this department many models, embossed books, and other objects of interest, but have taken an active personal share in the selection and arrangement of the whole collection. We may call special attention here to the beautiful specimens of work done in the Indigent Blind Asylum, and in the Associations at St. John's Wood, and at the Euston Road.

Of the miscellaneous objects of interest in the Sub-Class of apparatus, we may mention the models of improved desks and forms for school use, which are varied and skilfully adapted to the purpose. A desk and form exhibited by the Home and Colonial School Society is much used in schools. Mr. Haskins exhibits two instruments called the organ-accordion, which very much resembles the old accordion, with the exception of the keys, which are like those of a pianoforte. This instrument is intended for the use of schools and small places of worship. The compass of the instrument is three octaves. Mr. Curwen also illustrates in a very effective manner his musical system, which is doing so much to revolutionize the singing in our elementary schools. These are among the most prominent objects, but a large number of curious and useful devices for facilitating instruction, in various forms, will be found both on the north and south sides of the room.

C. Toys and Games.

No attempt has been made to confine the exhibition in this Sub-Class to such toys as have a distinctly educational purpose; the centre of the apartment will, therefore, be found to contain a great many articles which, though very beautiful and interesting, appear somewhat out of place in the educational division. Foremost among these are the magnificent dolls of Messrs. Montanari, the new games invented by Jaques and Son and by Mr. Cremer, and the toys by Messrs. Mead and Powell.

But besides these the centre of the room contains many objects which serve the double purpose of amusement and education: such are, the contrivances for physical education, the Rugby footballs, exhibited by Mr. Gilbert; and the articles used in cricket, which are furnished by Messrs. Dark, Duke, and Feltham. A very interesting display is made by Dr. Roth, of models illustrative of his somewhat elaborate system of physical training.

D. Illustration of Elementary Science.

In this department are included two divisions, which were originally intended to be separate,—those of natural history, and philosophical apparatus. The natural history collections are not numerous; the most prominent objects in this department being very fine specimens of the heads of a lion and of a tiger, exhibited by Messrs. Ward, a collection of British birds by Mr. Ashmead, and some specimens of birds by Messrs. Gardner and Bartlett. Mr. Highley, Mr. Wright, and Mr. R. Damon of Weymouth, contribute classified collections of geological and other specimens, intended to facilitate more methodical teaching of natural history than is usual in schools. Of the philosophical apparatus, that of Messrs. Statham will deserve the greatest attention, on account of its adaptation to educational purposes. Some very interesting and scientific diagrams, intended to illustrate the elementary truths of physical science, are also exhibited by Messrs. Johnston, of Edinburgh, and by Mr. Mackie. Of the objects in this room which are not specially educational in their purpose, the most remarkable are the beautiful scenes of chromolithographs and other engravings, exhibited by the Arundel Society. It is not so generally known as it deserves to be, that this Society has devoted itself to the reproduction of many of the choicest and least accessible works of the earlier Italian masters. Many of the frescoes of Giotto, and of Angelico, and of Masaccio, have been discovered in a neglected and decaying condition, in convents and half-ruined chapels in Italy. The diligence of the Arundel Society has in many cases rescued them from oblivion, while the fidelity and care with which the engravings have been made to represent the character of the original paintings are worthy of all praise. Although somewhat out of place in an Educational Court, their beautiful works are well displayed at the top of the staircase, and are amongst the chief attractions of the Central Tower.

Beyond this excellent general notice, it appears necessary to refer more particularly to a few of the educational collections exhibited, especially those immediately connected with science.

NATURAL HISTORY.

Mr. Charles Robertson is the exhibitor of an exceedingly well-arranged zoological series, with dissections. These embrace the vertebrate animals—from the common rat, showing its nervous circulatory and digestive systems, and its skeleton—to the bi-concave vertebræ of Angler (*Lophius piscatorius*). The Invertebrata, the beautiful series commencing with the edible snail, with its shell and dissections, showing systems and organs, and ending with the sea anemone and *Sertularia abietina*. A careful study of this collection is not to be expected by any visitor to the International Exhibition; but in the quiet of a well-organized museum, where the requirements of the studious few are cared for, rather than the curiosity of the sightseer, it would prove of the highest value.

Mr. Highley's collections have been already noticed. Passing over his collection of photographic apparatus (the applications for taking photographs of living microscopic objects, however, well deserves attention), we would point especial attention to his series, which are intended to illustrate, and they do illustrate, all the physical characteristics of minerals. No study can be more useful than this in a country where so large an interest is involved in the discovery of minerals, and in their useful applications.

The mineralogical and geological collections of J. H. Gregory, of E. M. Henson, and of B. Wright, which are entirely out of place in this Gallery, are of a very superior character; many of the minerals exhibited are rare specimens and of a very fine character.

THE TONIC-SOL-FA METHOD OF TEACHING TO SING.

Origin and Progress.—About the year 1812, Miss Glover, the daughter of a clergyman of the Church of England, commenced teaching children to sing by means of a "musical ladder" and a simple notation of letters taken from that ladder. This system she published under the title, "Scheme for rendering Psalmody congregational." At the close of A. D. 1840, Mr. Curwen taught himself to read simple music by the help of this book, and became convinced himself, by experiment and study, of its educational and scientific truth. On this system he founded, with Miss Glover's consent, the Tonic-Sol-fa Method. He has endeavoured to adapt this method to the various wants of the school, the home, and the church, by publications; and to propagate it by lectures and the encouragement of the best teachers. The simplicity, the cheapness, and, above all, the moral purposes of this method, have won for it many devoted and most active friends. A very large number of these friends necessarily remain unknown to Mr. Curwen, but he has recently obtained "Census returns" from a thousand teachers who are now giving lessons to 47,000 children, and about the same number of adults. The progress of the method has been steady and constant under the *sole patronage* of its pupils.

The Main Principle.—This method teaches the pupil to measure his intervals (not from any fixed sound in the region of absolute pitch, but) from that sound which is fixed on, for the occasion, as the governing or key-sound of the tune to be sung, whatever may be the place of that key-sound in absolute pitch. This is the simpler and surer plan, because there is an *invariable rule* of measurement, the same in all keys, when you start from the governing tone,—but the measurement *differs* with every new key when you take it from a fixed sound of *absolute* pitch. The pitch of the key-tone is first found from the scale of C, and then all the other measurements are *relative* to that. This is also the *oldest* plan of teaching interval to the human voice. Only organs and pianos have tempted men away from it. It is generally allowed that there can be no true sight-singing without bearing the key-tone in mind; but, as General Thompson has said, "There wanted something to *enforce* and *necessitate* the referring of all intervals to the key-note. This key-note (or more properly tone) is called the tonic. Hence the *Tonic*-Sol-fa Method of teaching to sing.

The advantages which are likely to be derived from the extension of the study of the science of music and harmony, induced the author to insert Miss Glover's own remarks on the article which that lady exhibits.

"The Sol-fa Harmonicon, containing a single row of plates and two rotary indexes, has never yet been executed to the satisfaction of the inventor of the instrument. Being only an amateur, therefore, unversed in commercial transactions, but deeply interested in the promotion of the musical education of the people, she would rejoice if skilful artisans, British or Foreign, should feel inclined to manufacture, on their own account, instruments of similar construction, but of superior workmanship, and of such a price that they might be within reach of the majority of the patrons of the Sol-fa notation of music.

"The following deviations from the model exhibited would be considered improvements:—

"1st. Let the centres of the plates be at equal distances, as such an arrangement would facilitate to the performer the measurement of the intervals, by avoiding a difference between the upper and lower octave. Though some compactness in the instrument would thus be sacrificed, ample compensation would be obtained by the increase of standing room afforded to the performance of music in parts.

"2nd. Let the cylinder be of larger circumference, for the sake of making *index to notes* more legible, and for the sake of allowing room to place some distinguishing mark over all the tonic sin *index to sol-fa letters;* for example, a gold spangle over every DOH, and a silver spangle over every LAH.

"3rd. Let there be a small space in the *index to notes*, between the two staves bearing the signature of six sharps and that of six flats.

"4th. Let the cylinders be turned by pins inserted in the central circle of the index instead of handles projecting beyond the sides of the box."

EDUCATION OF THE DEAF AND DUMB.

Exhibitor.—Dr. W. R. Scott (5420).

Those persons who are born deaf and dumb, or become so at an early age, require special and peculiar methods for their education, and unless they have this particular instruction, which their case demands, they remain through life in a state of sad isolation and ignorance. Their want of hearing and speech shuts them out from holding communication with their fellow-men, and hence they are unable to advance themselves by the means of "self-help" out of their unhappy condition. Dr. Scott exhibits three works on the subject of their education. The first contains an exposition of the effects which deaf-dumbness produces on the intellectual, moral, and social character, together with an historical sketch of the attempts made to educate the deaf and dumb, and an examination of the kind of education best fitted to ameliorate their sad condition. The two other works by this author contain a series of lessons to aid them in their study of language, and are so illustrated by pictures, and simplified by arrangement, as to render the acquaintance of English phraseology as easy as it can be made. Much care and thought have been used in the construction of these lessons; and they have had the advantages of extensive experience in the education of children thus afflicted.

DR. MATHIAS ROTH'S MODELS ILLUSTRATING THE MOVEMENT CURE.

Dr. Roth's aim in exhibiting his collection is to contribute to the practical knowledge of a rational mode of physical education based on sanitary principles, and thus to prevent a number of deformities and chronic ailments which, according to his experience, and according to the opinion of many other medical men, are frequently occasioned only through ignorance and neglect of the elementary principles of rational physical education.

This educational collection, fortunately, is for itself, in the main, sufficiently explanatory; there are, however, some things which it would have been desirable to have described with care, if it had been possible, within the space to which this work is confined, to have done so. There is, however, one collection of stuffed Fishes by a coast-guardman of Polperro, in Cornwall, whose name is not to be found in the catalogue, nor in the Juries' Awards, but to which it is desirable to point attention. These are the work of a labouring man, and rarely has it been that fish have been more carefully mounted than those now exhibited.

CLASS XIV.—PHOTOGRAPHIC APPARATUS AND PHOTOGRAPHY.

Number of Exhibitors, 158.

SITUATION OF CLASS.—*The Central Tower. This Class is reached by the stairs immediately adjoining the entrance to the British Picture Gallery.*

Position of Groups.—The numbers commence at the South-west corner of the Room. On the screen next the Entrance Staircase are arranged views, and a few portraits—amongst others those enlarged by the solar camera. Then others are arranged on the South-west Screen, again on the North-west Screen, and on the South-east Screen; Painted and coloured photographs against the wall.

Photography, as an art, has taken a high position; and with the facilities afforded by the collodion processes, and by the persevering zeal of the lovers of photography, a remarkable degree of excellence has been attained. As a science, photography is at a dead stand; with a host of indications, promising to lead to results of the highest importance in physical science, and to furnish effects of a yet higher character than any with which we are acquainted, nothing has been done for years.

In the applications of photography to the investigations of science, much has been effected. We may refer to the self-registering magnetic apparatus, described at page 196, and to the series of photographs of spots on the sun, by Mr. Beckley. The application of photography to astronomical science, as exhibited by this gentleman, and the extensive, instructive, and beautiful series exhibited by Mr. Warren De la Rue, in the Gallery of the North Court, are of the highest interest.

In another direction, it may be said that scientific knowledge has been brought to bear on photographic art.

Many years since, Mr. W. H. Fox Talbot, availing himself of discoveries made independently by Mr. Mungo Ponton and the author of this *Handbook*, on the peculiar conditions established upon the bichromate of potash, in connection with organic matter, under the influence of sunshine, patented a process for engraving on copper and steel. (See *Researches on Light, by Robert Hunt, 1st Edition* (1844), *page* 163; *2nd Edition* (1854), *page* 175. *The chromatype process was published in* 1843.)

Mr. Paul Pretsch also introduced a process of a similar character, of which he now exhibits specimens. In both of these the action depends upon the liberation of chromic acid from the bichromate of potash, and the combination of this with gelatine, by which it is rendered insoluble.

MM. Pretsch, Poitevin, and Talbot, and, more recently, Sir Henry James and others, have only availed themselves of this previous discovery, and in each instance gelatine is rendered insoluble by the decomposition of the bichromate of potash under the influence of *actinic* power. By dissolving off the still soluble portions of the gelatine, metal can be precipitated by the voltaic battery, or an etching produced.

In 1853 M. Nièpce de St. Victor, the nephew of Nicephore Nièpce, took up his uncle's plan, and, with the assistance of M. Lemaitre, who had also assisted his uncle, endeavoured to perfect it: but, though he modified and improved it, his success was not very great; it was always found necessary to have the assistance of an engraver to complete the plate.

After this, many others, among whom may be enumerated MM. Lerebours, Lemercier, Barreswil, Davanne, and, finally, Poitevin, endeavoured to obtain a design by similar means on stone. The last appears to have succeeded. His method is based on the chemical reaction of light on a *mixture of gelatine* and *bichromate of potash*, as above. This mixture, which when made is perfectly soluble in water, becomes insoluble after exposure to the light. His mode of proceeding is as follows: —He spreads the mixture on the stone, and, after drying, lays the negative upon it and exposes it to the light. After a suitable exposure the negative is removed, and the portions not acted upon by the light are washed away with water, and the design remains, with the property of taking the ink like an ordinary lithographic crayon. The stone is then transferred to the press, and proofs taken in the usual way. It is said that excellent pictures have been obtained from the stone after 900 copies had been pulled.

Photozincography.—This is a name given by Colonel James, R.E., Director of the Ordnance Survey, to a process which he has lately introduced, and which has been carried out to some extent in the Ordnance Map Office, at Southampton, for the purpose of copying ancient documents. In a report just made to the House of Commons (March, 1860), Colonel James thus describes his process. After speaking of some experiments made with the carbon-printing process, he continues:—

"We have also tried a method, which is still more valuable, and by which the reduced print is in a state to be at once transferred to stone or zinc, from which any number of copies can be taken, as in ordinary lithographic or zincographic printing, or for transfer to the waxed surface of the copper plates. To effect this, the paper, after being washed over with the solution of the bichromate of potash and gum, and dried, is placed in the printing-frame under the collodion negative, and, after exposure to the light, the whole surface is coated over with lithographic ink, and a stream of hot water then poured over it; and as the portion which was exposed to the light is insoluble, whilst the composition in all other parts being soluble is easily washed off, we obtain at once the outline of the map, in a state ready for being transferred either to stone, zinc, or the copper plate, or we can take the photograph on the zinc at once.

"This new method of printing from a negative is extremely simple and inexpensive, and promises to be of great use to us. Sheet 96, of Northumberland, has been transferred to the copper plate from impressions taken by this process, and from the perfect manner in which we are able to transfer the impressions to zinc, we can, if required, print any number of faithful copies of the ancient records of the kingdom, such as

Doomsday Book, the *Pipe Rolls*, &c., at a comparatively trifling cost. I have called this new method photozincography, and anticipate that it will become very generally useful, not only to Government, but to the public at large, for producing perfectly accurate copies of documents of any kind."

The examples exhibited will show the great advantages of this beautiful process.

CAMERAS, APPARATUS, AND TENTS.

It is not possible to do justice to the beautiful series of photographic apparatus here exhibited. Lenses cannot be described—they must be tested. J. H. Dallmeyer has, however, made a great advance in the new tripled lens, with the chemical and visual foci coincident. Ross's lenses are also of the highest excellence. The cameras are of every kind, and of very varied degrees of excellence; the other appliances are, generally speaking, of the most useful character.

Smart's tent, made by Murray and Heath, is one of the most useful things introduced for the traveller. It is rectangular in form, is 6 feet high in the clear, and 3 feet square, affording table space equal to 36 inches by 18 inches, and ample room for the operator to manipulate with perfect ease and convenience. The chief feature in its construction is the peculiarity of its framework, which constitutes, when erected, a system of triangles, so disposed as to strengthen and support each other: it thus combines the two important qualities of lightness and rigidity. The table is made to fold up when not in use; and in place of the ordinary dish for developing, a very efficient and portable tray is provided, made of india-rubber cloth, having its two sides fixed and rigid, and its two ends movable; it thus folds up into a space but little larger than one of its sides. The working space of the table is economized thus:—a portion of it is occupied by the tray; the silver-bath is suspended from the *front* of the table, and rests upon a portion of the framework of the tent; a contrivance is devised for disposing of the plate-slide of the camera, in order to reserve the space it would require if placed on the table. This arrangement leaves ample space on the table for manipulating the largest-sized plates. The entire weight of the tent is 20 lbs., and it is easily erected or taken down by one person.

PORTRAITS.

Amongst the portraits, which are, by the careful "touching" or painting they have received, strictly speaking, removed from the province of photography into that of art—still mechanical art, it must be confessed—the most striking are those of Mr. Claudet. The peculiar conditions under which these pictures have been produced cannot be better given than in Mr. Claudet's own words.

"The possibility of enlarging small photographs is at present engrossing the attention of the photographic world, and there is no doubt that it is a considerable advantage in many respects. Small pictures are produced with the greatest facility, and with a perfection which cannot be obtained by large lenses and complicated apparatus. For taking views, the operator need not encumber himself with any heavy baggage, and he may carry all his appliances packed in a moderate compass. Small glass negatives are less subject to be injured or broken in travelling, and may be contained in a light box. For taking portraits, the preparation of plates is very simple and rapid, the *pose* is nearly instantaneous, and consequently the expression is not constrained and unnatural. Small lenses, operating at a great distance from the sitter, give an image without distortion and exaggeration of perspective. All is perfect in small pictures; and before an audience of experienced photographers I need not do more than mention the fact, that if we enlarge such small pictures, we obtain portraits of great beauty, characteristic in countenance and correct in form.

"The solar camera is the means by which we are enabled to enlarge photographs; and if we could depend upon the sun more than it is possible in our latitude and climate, nothing would be easier than this operation; but, unfortunately, the sun does not shine every day, and sometimes we may be waiting for his beneficial influence during many long weeks.

"The enlargement of negatives, however, has some limits when we wish to produce black photographs. I think that an enlargement of from six to eight times is the greatest proportion that ought to be employed. But if we wish to enlarge *cartes de visite* to the size of nature, the small defects, imperceptible in the negative, are magnified to a degree so apparent, that the picture requires considerable touching up and correcting, in order to give it the appearance of a perfect and clean drawing worthy of being framed. These corrections, however, can be made without altering the character of the photograph, which has all the qualities of the small *carte de visite*, preserving the proportions of all the forms and the natural expression of countenance. The result is far preferable to all the attempts to produce at once large portraits with lenses of considerable aperture, which require a long sitting, distort the proportion of the figure, and, if the model has not moved, exhibit the forced expression of a sitting too much prolonged. Although, as photographs, many parts of the figure which may be in the right focus require very little touching up, still the greater part is so ill defined and so much out of proportion, that it is absolutely necessary to modify it considerably. The touchings of enlarged photographs, at all events, can be done without altering any proportions; and when these pictures are destined to be painted or coloured, they are in even a better condition for the artist than more strongly-marked photographs taken direct on a large size.

"The principal object of taking photographic portraits as large as nature is to give to the artist a ground to paint upon, containing a correct representation of all the features, forms, and draperies, which he can follow until the picture is so far advanced that a short sitting of the person is sufficient to impart the exact colour of the eyes, hair, and complexion.

"I have tried the experiment, and it has answered beyond my expectation. In the British department of photography at the International Exhibition may be seen several portraits, as large as nature, which have been painted on canvas, upon which were enlarged pencil-drawings of a small negative. I have done it myself; and when I add that I am quite incapable of drawing, it must be acknowledged, by the inspection of the result, that, being entirely due to the help of photography, it is one of its most useful applications.

"I have thought that this mode of forming the base for large portraits upon canvas (the usual and most suitable surface for the work of the painter) deserved the attention of photographers who, to satisfy the wants of the public, are obliged to employ artists to produce painted portraits. If it is found that this mode of operating is capable of results entirely satisfactory, and that it can be effected at any time when wanted, without the light of the sun, surely this must be considered as a great advantage in one of the most important applications of photography, which consists in furnishing the artist with a perfect base for painting portraits, having all the truth and character of painted photographs, and so easy to be obtained."

The pictures exhibited by Mr. Kilburn are, as photographic portraits, amongst the best exhibited, and the colouring of them in demi-tint is just sufficient to give the finish which is thought necessary for a drawing-room picture, without obscuring the beauties of the photograph.

The highly-finished productions from this exhibitor are very close approaches to the finest works of the miniature painter.

T. R. Williams, J. E. Mayall, Vernon Heath, Maull and Polyblank, with many others, exhibit portraits; but these are generally too well known to require any description or to demand any praise.

OTHER PHOTOGRAPHS.

The exceeding beauty of many of the landscapes tempts one to dwell upon their merits, and it is with difficulty that we are restrained from selecting and praising those which are of the highest excellence. This, since it is not possible to do justice to the series, must, however, be avoided.

STEREOSCOPIC SLIDES.

The Stereoscope (from στερεος, solid, and σκοπειν, to see) is an instrument invented by Professor Wheatstone, and modified by Sir David Brewster, by means of which two images of the same object, depicted on paper—as those images would be depicted upon the retina of each eye—are resolved into an apparent solid of three dimensions. The reflecting stereoscope of Professor Wheatstone was constructed by means of two mirrors, set at right angles to each other, so that while the right eye observed a reflected image of a picture placed on the right-hand side of the instrument, the left eye saw a reflected image of that on the left, and, as a result, saw—not two plane pictures, but one solid image. The refracting stereoscope, which is generally used, consists of two semi-lenses. This is a lens which is divided in the middle, and the two halves, with the edges towards each other, placed in a frame, at a distance from each other corresponding with the distances of the eyes apart. For the best result, two pictures are obtained, by photography, as nearly as possible of the same character as the pictures impressed respectively upon the retina of each eye. These pictures, being placed below the lenses, are resolved into one image, and that image realizes all the conditions of solidity, as in natural vision. (See *Hunt's Manual of Photography.*)

The stereoscopic slides exhibited, being carefully selected, are of unusual excellence.

The space allotted in this small work for the consideration of the British Industries has been exceeded, and the Textile Manufactures must even now encroach upon pages which should be given to the Colonies. It has, therefore, been necessary, after all the names of the Photographic exhibitors were in type, to withdraw them; and without noticing any especially, the reader is recommended to examine all of the fine photographs exhibited.

CLASS XXIII.—WOVEN, SPUN, FELTED, AND LAID FABRICS, AS SPECIMENS OF PRINTING OR DYEING.

Number of Exhibitors, 52.

SITUATION OF CLASS.—*South-east Gallery, near the centre of the Building, separating Cotton, Class XVIII., from the Products exhibited by Italy.*

This Class so completely embraces—and is embraced by—all the other classes devoted to the textile fabrics, and by Chemistry, Class II., that little can, independently, be said of it.

The samples of goods exhibited by Messrs. Samuel Barlow and Co., are remarkable, in the first instance, for the bleaching which is effected by Mr. Barlow's patent kiers, with a great economy of time, labour, drugs, and fuel, while the colouring matters, and all other impurities being entirely removed, the bleaching is most perfect.

The following in reference to these kiers is from "Ure's Dictionary," edition 1860, by Robert Hunt, F.R.S.

"This method of Mr. Barlow's is an undoubted shortening of the process of bleaching. It will be seen that the steam drives the solution through the cloth; and this is equal to the process of stirring, which is a continual change of surface and of liquid, but is more effectual than any stirring could possibly be. The liquid cannot run through ruts and crevices, but must run through the cloth itself."—*Art. "Bleaching."*

"The bleaching requisite for printing cloths is of a much superior nature to that sufficient for calico intended to be sold in the white state. It is sufficient for the latter to be white enough to please the eye, a result easily obtained by chlorine treatment after a comparatively mild alkaline boiling; but the former must be so well boiled with lime and alkali, as to remove every particle of resinous and glutinous matter previous to the chlorine steep. This, if not attended to, becomes a source of great annoyance to the printer in his subsequent operations, from the difficulty of obtaining sufficiently good whites without injuring the colours. The high-pressure kiers, patented by Barlow, have been found to facilitate the thorough scouring of the cloth very much, at a less cost than the old kiers."—*Art.* "*Calico Printing.*"

The bleach is of especial value to calico printers doing madder and garamine styles, and specimens of it are shown in juxtaposition with an ordinary madder block in the white, washed out of the madder dye, and in the cleared states. The specimens have been passed together through all the processes subsequent to bleaching.

In dyeing, the effect of the bleaching is that the shades and colour are brighter; most of the samples of dyes exhibited are dyed by original processes: the mauves, magentas, and other aniline colours, are dyed by a process, by which the greatest amount both of fixity and brilliancy, which these colours are capable of, on cotton, is attained.

The exhibitors of dyes have confined themselves merely to the Chemical Class: there will be found all the aniline dyes (see Vol. I., page 110). Here there are only a few illustrations of these; there are also a few examples of the use of archils.

Archil liquor, archil paste, and cudbear, are different forms of the same dye, being developed from the various colour yielding lichens by the combined agency of ammonia, heat, and air.

The different tints of colour exhibited in the specimens are produced by modifications of the application of these agents. These dyes attach themselves readily to silk, wool, leather, and all animal substances, without a mordant; but no means have yet been discovered to fix them upon cotton. Orchelline is the pure colour first developed in the ordinary way in the form of archil liquor—which is an ammoniacal extract—and then precipitated by an acid.

This precipitate has been found to possess greater stability than the ordinary preparation, and has been extensively used, in combination with extract of indigo, in dyeing silk, mauve.

Amongst the examples of re-dyeing and cleaning, the articles exhibited by Daily and Co. deserve attention: these are—

Dyeing and re-watering Moiré Antiques.—A moiré antique skirt much soiled, dyed various colours, and, by an improved method, the original brilliancy and beauty of the moiré antique water perfectly restored or reproduced.

Dyeing and finishing Velvet.—The greatest difficulty presented in the treatment of velvet, is, when the pile has been crushed by wear, to raise and restore it as when new: much thought and many experiments have lately led to the application of a chemical preparation, by the judicious use of which, with other restoratives, combined with much skilful labour, the desired result is effected. As a specimen of this class of work, part of a velvet dress is exhibited, the colour revived, the flushed appearance of the pile removed and restored to its original condition.

Dyeing, cleaning, and embossing Satins.—A satin skirt, also much soiled and faded, dyed various colours and embossed. By a superior process of embossing, old-fashioned satins, however soiled or faded, can be made to resemble rich fashionable brocades.

CLASS XVIII.—COTTON.

Number of Exhibitors, 60.

SITUATION OF CLASS.—*In the South Gallery, running along between the Nave and the South Court.*

SEWING AND EMBROIDERY COTTONS.

Exhibitors.—**E. Ashworth and Sons (3640), J. Brook and Brothers (3644), J. Carlisle, Sons and Co. (3646), Clark and Co. (3649), J. Clark, jun., and Co. (3650), L. P. Clarke (3651), J. and A. Coats (3652), Ermen and Engels (3657), W. Evans and Co. (3658), F. Ford (3660), W. Hastings (3665), J. Hudson and Sons (3672), Kerr and Clark (3677), S. Manlove (3681), J. T. Raworth (3689).**

The above exhibitors being the principal manufacturers of cotton-thread, show many varieties both in glacé and other thread. Though the minor details of some may differ, it is all alike made by a process of doubling and twisting cotton or linen yarn into a compact thread by means of a machine resembling the throstle of the cotton-spinner; and, by adapting change pinions and their corresponding wheels to the rollers, the delivery of yarn may be increased or diminished in any degree, so as to vary the degree of twist put into it by the uniform rotation of the drum and spindles. The yarn, during the process of manufacture, has to be frequently *gassed*, or passed quickly through a series of coal-gas flames, to singe off any loose downy fibres before it is taken to the doubling and twisting frame. There is one case of cotton, however, which has not been gassed, for the purpose of showing the difference.

MUSLIN, MUSLIN CURTAINS, AND EMBROIDERED MUSLIN.

Exhibitors.—**Auld, Berrie and Mathieson (3641), Brown, Sharps and Tyas (3645), Copestake, Moore, Crampton and Co. (3654), G. Hamilton (3664), J. R. Jack (3673), S. Northcote and Co.**

(3686), R. Outram and Co. (3687), T. Sprunt and Co. (3692), R. B. Symington and Co. (3694), T. and D. Wilson and Co. (3696), Yates, Brown and Howat (3698), J. H. Young and Co. (3699).

The name *muslin* is supposed to be derived from Masalia, since called Masulipatam, from which place such fabrics were first imported into Europe. Until the early part of the present century, all the muslin used in Europe was of Indian manufacture. These fabrics are still superior to any that are made in Europe, both as regards their fineness and their durability, which latter quality is not, as has been supposed, the consequence of any superiority in the nature of the material of which they are made; for the raw cotton of India is far inferior to that which is used for these fine fabrics in Europe, and which is brought from America and Egypt, but their excellence is owing to the skilfulness and patience of the spinners and weavers of that country. Such, however, has been the result of the mechanical inventions of England in this branch of industry, that not only are muslins of British manufacture now used at home to the exclusion of those woven in India, but large quantities are exported to all parts of the world, and find their way even far into the interior of India. The great seat of the muslin manufacture in this country is Paisley. The greater part of the yarn used for these fine fabrics is spun in the cotton mills of Manchester; they are made both plain and figured, examples of each being exhibited. Muslin embroidery by machinery is a very interesting portion of this exhibition. The Scotch needlework is very beautiful, and deserves notice; some fine examples being shown in cases 3654, 3645, 3686; the beauty of the finish and work being only excelled by the elegance of design. Several muslin and leno window curtains are sent by various manufacturers, possessing no novelty, but exhibiting great variety of design.

There are some few exhibitors of yarns used for sewing cotton. F. Ford sends some spun wondrously fine; one skein of single cotton yarn, No. 700, is so fine, that a pound weight would extend 588,000 yards, or about 334 miles; but there is a small quantity of still finer yarn, No. 2500. Townsend and Son have a case in which is exhibited cotton thread prepared for gloves, ribbons, elastic fabrics, and the like. Faulkner has a very excellent collection of cotton twine; it weighs lighter than hempen twine, for in the same weight it is 30 per cent. stronger.

COUNTERPANES, DIMITIES, &c.

Exhibitors.—**Barlow, Goody and Jones (3642), W. M. Christy and Sons (3648), J. Johnson and Fildes (3674). Martin, Johnson and Youle (3683), R. Outram and Co. (3687), J. Phillips (3688), W. J. Smith and Co. (3691).**

The counterpanes, quilts, and cotton blankets, are of excellent manufacture. The dimities are also very excellent. Only the ordinary plain striped dimity is exhibited in this class; in Class XXIII. are some printed ones, which have but recently been adopted.

CALICOES, SHIRTINGS, LININGS, &c.

Exhibitors.—**Crewdson and Worthington (3655), Gills and Hartley (3661), Goodair, Slater and Smith (3662), Greenwood and Whittaker (3663), J. Hawkins and Sons (3666), R. Haworth and Co. (3667), E. Hollins (3668), R. Hopwood and Son (3669), Horrockses, Miller and Co. (3670), J. T. Kenyon and Co. (3679), Lowthian, Fairlie and Co. (3679), Marland and Whitcombe (3682), Swainson, Birley and Co. (3693).**

As the process of spinning and weaving cotton has been described in a previous part of this work, Vol. I. p. 250, it need not be again inserted. The calicoes, &c., here exhibited vary from the coarsest to the finest quality; but as there are samples on the exterior of each case the visitor can examine for him or herself. There is also a great display of drills, ginghams, linings, and the numerous variety of fabrics of which cotton forms entirely or in part the material.

CLASS XXIV.—TAPESTRY, LACE, AND EMBROIDERY.

Number of Exhibitors, 85.

SITUATION OF CLASS.—*This Class is in the South-east Gallery, crossing from Class XVIII to Class XX.*

The display of lace from the manufacturers of the United Kingdom is indeed astonishing, and is unsurpassed in the whole Exhibition. A visible progress has been made of late years in the manufacture of the commoner kinds of lace and the imitation laces, most of which are now made by power-looms in place of being, as formerly, made by hand. The machinery by which this is done is extremely complicated, and not capable of being explained in the small space we are enabled to devote to the subject. Lace is a fabric which differs essentially in form and appearance from the products of an ordinary loom, and until the early part of the present century was made without the employment of machinery. The implements used by hand lace-makers are few in number, and inartificial in their character. They consist of a pillow or cushion, a series of bobbins, or small cylindrical pieces of wood, round which the silk or silk-thread employed is wound,—and pins, which are stuck into the cushion, and around which the threads are twisted, the pattern of lace being determined by the disposition of the pins, and this again being regulated by holes pierced in a piece of parchment, which is laid upon the cushion. One of these is exhibited. It is not possible to give in writing an intelligible description of the processes of lace-making by means of these implements; but it will be understood that the effect is produced by the twisting together of the threads upon the bobbins, and their being woven in among and around the pins, the pattern of the lace depending partly upon the order of arrangement preserved in these twistings and weavings, and partly upon the introduction of a thicker thread, called *gimp*, which is used to make flowers and other ornaments. The principal seat of the lace manufacture in England is Buckinghamshire, but the most esteemed qualities are imported from foreign places, among which Mechlin, in Belgium, long maintained preeminence. Of late years, lace-making, as formerly conducted, has very much declined in this country, owing to the greater cheapness of machine-made lace, better known as bobbin-net, the manufacture of which has increased beyond all expectation both in England and France. The manufacture is principally carried on in and about Nottingham, Leicester, Derby, and in the West of England. The lace manufactory of Honiton has been long celebrated. Many of the beautiful works exhibited are from that district.

Howell and James (4422) exhibit a magnificent dress, which is valued at two hundred and fifty guineas. There is also a Honiton flounce having a guipure border of a fern pattern, which is worth two hundred guineas. There are also many other articles of the same description of lace, such as parasol covers, handkerchiefs, collars, cuffs, &c., shown in these and other cases, possessing great beauty both in design and workmanship.

The Irish lace is exhibited in great variety and quantity: of very beautiful crochet, worked principally in the schools. there is a large assortment. The other varieties of lace which are produced in Ireland, are point, appliqué, tatting, guipure, and a lace of the same make, only finer and more open, called royal guipure. Of each of these varieties several most beautiful specimens are displayed in dresses, veils, and smaller articles. There is one dress of Brussels lace pattern also of Irish manufacture.

The Nottingham and Leicester lace manufactories have sent a very large display; most of it is machine-made, and imitation, but so exquisitely manufactured, that it would require a practised eye to discover the difference unaided by the sense of touch. There is scarcely any description of lace which is not imitated: in some cases the real is put beside it, yet the machine lace bears the comparison well.

We have hand lace from Cranbrook, Banbury, and Bradford, and a collective exhibition from Buckinghamshire, Bedfordshire, and Northamptonshire; Kidderminster and West Cowes, also contributing. Embroidery by hand and embroidery by machinery are side by side, the latter coming from Manchester, the former from Preston, High Wycomb, Taunton, Windsor, Druse, &c. There are several fine collections contributed by London tradesmen. Messrs. Debenham, Son and Co. exhibit—*Black lace tunic* of elaborate design and finest quality, manufactured on the pillow in Buckinghamshire—value sixty guineas. *Deep Honiton lace flounce* of very finest quality—top part, sprigs and bouquets of wild flowers applied, with border of fern leaves in guipure—value two hundred guineas. To these may be added a black Nottingham lace shawl; white Limerick lace ditto: both elaborate and novel designs. Rich Honiton guipure parasols, collars and sleeves, pocket-handkerchiefs, &c., &c.

Gold lace, coach lace, trimmings, braidings, frillings, and commercial Berlin work, may be classed as the extensive sundries of this Class.

The embroidery exhibited by R. Abraham and Sons is well deserving attention. The collection consists of an embroidered mantle, as used in the Jewish synagogues, as a covering for the manuscript rolls of the law, made of green velvet, embroidered in gold; the inscriptions on the scrolls and tablet being in the Hebrew characters, and appropriately selected from various parts of the Old Testament. A scarf or garment of fringes, worn during divine service, in accordance with Numbers xv. 37—41; being a silken scarf, with blue threads interwoven, and with gold-embroidered corner-pieces, through which are inserted fringes, each composed of eight threads, in a peculiar numerical order, each combination having a reference to some religious observance. The covering for the Bread of Sanctification, used in Jewish families on Sabbaths when invoking a blessing on the food—of crimson velvet, ornamented in gold, the inscription in Hebrew, having allusion to the special miracle attending the manna, a twofold portion of which fell on the days immediately preceding the Sabbaths: in commemoration of which *two* loaves are always placed, even to the present day, under the sanctification covering for the Sabbath blessing. The case also contains various specimens of embroidery, laces, and other articles for military ornament.

CLASS XX.—SILK AND VELVET.

Number of Exhibitors, 64.

SITUATION OF CLASS.—*South-east Gallery, from near the entrance to the Picture Galleries, and running Eastward.*

SILK AND VELVET.

South-east Gallery.

The great improvement which has taken place in the silk manufactures of our own country since the Exhibition of 1851, cannot fail to be noticed, when paying a visit to this gallery.

Silk manufacture may be divided into two branches:—1st, the production of raw silk; 2nd, its filature and preparation in the mill for the purposes of the weaver, and other textile artizans.

There are three denominations of raw silk, viz., organzine, *trame* (shute or tram), and floss. Organzine serves for the warp of the best silk stuffs, and is considerably twisted; tram is made usually from inferior silk, and is very slightly twisted, in order that it may spread more and cover better in the weft; floss, or *bourre*, consists of the shorter broken silk, which is carded and spun like cotton.

The following remarks on the silk husbandry of France may not be uninteresting:—

The silk husbandry, as it may be called, is completed within six weeks from the end of April, and thus affords the most rapid of agricultural returns, requiring merely the advance of a little capital for the purchase of the leaf. In buying up cocoons, and in the filature indeed, capital may be often laid out to great advantage. The most hazardous period in the process of breeding the worms is at the third and fourth moulting; for, upon the sixth day of the third age, and the seventh day of the fourth, they in general eat nothing at all. On the first day of the fourth age, the worms proceeding from one ounce of eggs will, according to Bonafons, consume upon an average 23¼ lbs. of mulberry leaves: on the first of the fifth age they will consume 42 lbs.; and on the sixth day of the same age, they acquire their maximum voracity, devouring no less than 223 lbs. From this date their appetite continually decreases, till on the tenth day of this age they consume only 56 lbs. The space which they occupy upon the wicker tables, being, at their birth, only nine feet square, becomes eventually 239 feet. In general, the more food they consume the more silk they will produce.

In the Journal of the Asiatic Society of Bengal, for January 1837, there are two very valuable papers upon silkworms: the first upon those of Assam, by Mr. Thomas Hugon, stationed at Nowgong; the second, by Dr. Helfer, upon those which are indigenous to India. Besides the *Bombyx mori*, the doctor enumerates the following seven species formerly unknown:—1. The wild silkworm of the central provinces, a moth not larger than the *Bombyx mori*. 2. The Toree silkworm of Assam, *Bombyx religiosa*, which spins a cocoon of a fine filament, with much lustre. It lives upon the pipul tree (*Ficus religiosa*), which abounds in India, and ought, therefore, to be turned to account in breeding this valuable moth. 3. *Saturnia silhetica*, which inhabits the Cassia mountains in Silhet and Dacca, where its large cocoons are spun into silk. 4. A still larger *Saturnia*, one of the largest moths in existence, measuring ten inches from the one end of the wing to the other, observed by Mr. Grant, in Chirra Punjee. 5. *Saturnia paphia*, or the Tusseh silkworm, is the most common of the native species, and furnishes the cloth usually worn by Europeans in India. It has not hitherto been domesticated, but millions of its cocoons are annually collected in the jungles and brought to the silk factories near Calcutta and Bhagelpur. It feeds most commonly on the hair-tree (*Zizyphus jujuba*), but it prefers the *Terminalia alăta* or Assam tree, and the *Bombax heptaphyllum*. It is called Koutkuri mooga in Assam. 6. Another *Saturnia* from the neighbourhood of Comercolly. 7. *Saturnia assamensis*, with a cocoon of a brown yellow colour, different from all others, called *mooga*, in Assam, which, although it can be reared in houses, thrives best in the open air upon trees, of which seven different kinds afford it food. The *mazankoory mooga*, which feeds on the adakoory tree, produces a fine silk, which is nearly white, and fetches 50 per cent. more than the fawn-coloured. The trees of the first year's growth produce by far the most valuable cocoons. The mooga, which inhabits the soom tree, is found principally in the forests of the plains, and in the villages. The tree grows to a large size, and yields three crops of leaves in the year. The silk is of a light fawn colour, and ranks next in value to the mazankoory. There are generally five breeds of mooga worms in the year:—in January and February; in May and June; in June and July; in August and September; in October and November—the first and last being the most valuable.

When the worm has completed its spinning operation, the cocoon should not be allowed to remain many days without the silk being wound off, for the chrysalis will have time to grow and break through the filaments, and then the cocoons will lose almost all their value. The best means of extinguishing the life of the insect is by plunging tin cases filled with the cocoons in water, heated to 202° Fahrenheit. The silk is then wound off round a drum, one ell in circumference, and the quality of the silk is determined by the weight of 400 ells, at least this is the Lyons rule of valuing silk.

The reeling of silk only takes place in the country where the cocoons are produced: it reaches the weaver either as tram, organzine, or floss, the preparation of which is the business of the throwster. Plain silk weaving is much the same as woollen or linen fabrics, but the weaver is assisted by a machine for the even distribution of the warp, which frequently consists of eight thousand different threads in a breadth of twenty inches.

SILK.

Exhibitors.—**W. Adshead and Co. (3840), T. Ballance and Son (3843), Bickham, Pownall, and Co. (3845), Campbell, Harrison, and Lloyd (3851), J. Chadwick (3855), Cornell, Lyell, and Webster (3858), W. Corns and Co. (3859), Cox and Co. (3861), Cunliffe, Piggott, and Co. (3863), Elise and Isaacson (3866), Foot and Bird (3867), Keith and Co. (3876), Kemp, Stone, and Co. (3877), Le Mare (3878), Payn (3880), Peel, Greenhalgh, and Co. (3881), T. Seamer (3887), Smith (3892), Sudbury Local Committee (3893), S. Taylor (3894), D. Walters and Sons (3898), Wanklyn (3899), Winkworth and Procter (3901).**

A considerable advance may be observed in many of the designs, groups of flowers especially, their correctness showing a very careful study of nature. Some beautiful moiré antiques are exhibited: amongst them may be noticed a silver grey moiré, which is made of silk and solid silver thread woven together, which combined has a very striking effect. The figured chené silks exhibited are very chaste and elegant. Several of the plain silks and *glacés* are woven by the steam-power loom, which may be seen in operation in the Western Annex; those in Case 3856 are thrown into *organzine* in two operations from China cocoons, and into *tram* in one operation. There is one Case (3886), which is extremely interesting, as it contains specimens of silk in all its different stages, from the silkworm in the cocoon to the manufactured article, and each specimen is numbered, in order to be easily understood.

Some beautiful black silks are exhibited by Ballance and Son of Spitalfields, in all qualities, and especially of the richest fabrics that are made. This house has existed for nearly a century, and the present representatives of the firm are lineal descendants of the Norman refugees, who, at the Edict of Nantz, established the silk trade in this country.

There are some very beautiful examples of furniture silks, amongst which is the novel material, *tissue de verre*, exhibited by Grant and Gask: it consists of the pattern being of very fine spun glass, woven into the silk ground, and it produces the same rich effect as the embroidery in gold thread, to be seen in the Italian Court: it appears to be very flexible. The skeins of glass thread which hang in the same Case, and are the same as used in the furniture, illustrate this.

A great variety of silk handkerchiefs, cravats, scarfs, &c., are shown in this Class, but nothing of rarity.

VELVET.

Exhibitors.—**T. Ballance and Son (3843), Christy and Co. (3857), Kemp, Stone, and Co. (3877), Peel, Greenhalgh, and Co., and G. Whyatt and Co. (3881), T. Seamer (3887), Sudbury Local Committee (3893), S. Taylor (3894), Watson and Healey (3900).**

Velvet differs from other textile fabrics by having two rows of warp threads, one of which forms the regular warp, while the other constitutes the pile; and these two sets are so arranged in the loom, as to be kept separate. The quantity of pile thread necessary is very much more than that of the warp thread, and therefore must be supplied to the loom by a different agency. The pile threads are formed into a series of loops standing up from the surface of the silk; and by cutting these loops with a sharp instrument the pile is produced. The loops are formed in a very singular way. After the weaver has thrown the shuttle three times across, making the shoot interlace three times among the threads of the warp, he inserts a thin straight brass wire at right angles, to the length of the piece, or parallel with the shoot. The wire is so placed as to occupy a position through the whole breadth of the fabric, above the warp threads and below the pile threads; the treadle is then put to work, the alternate threads of the warp raised, and the shuttle thrown again, by which a shoot thread is thrown over the pile thread, and also over one half of the warp threads, the wire becoming thus, as it were, woven into the substance of the fabric. Two more traverses of the shoot are then made, passing alternately over and under the warp threads in the usual way, but not interfering with the pile thread. Another wire is then laid in, below all the pile threads and above all the warp threads, and this is secured by subsequent shoot threads as in the first instance. By a most delicate and difficult operation these wires are removed by the same operation as produces the pile: each wire is nearly a semi-cylinder in form, and has along its upper surface a carefully-constructed groove, and along this groove the weaver passes the sharp edge of a cutting instrument, called a *frevat*, severing pile threads in his progress, and these cut threads constitute a pile long enough to hide the fabric underneath. There is a loom of this kind, from which are produced the best velvets to be seen in the Process Court of the International Exhibition. Many velvets are now manufactured by steam-power; but these are principally union velvets; that is when the threads which form the warp are of cotton, and the pile thread is silk: some velvets of this kind are exhibited with the others.

Kesselmeyer and Mellodew's imitation velvets are extremely good, the ones with silk face and cotton back especially so; the pile is so firmly woven into them that there is not that aptitude to pull out, as in many velvets of a similar nature.

RIBBONS AND TRIMMINGS.

Exhibitors.—**J. Banks and Co. (3844), F. Browett (3849), Caldicott and Co. (3850), Carter and Phillips (3853), J. Cash (3854), Cornell, Lyell, and Webster (3858), Cox and Co. (3861), Dalton and Barton (3864), W. Franklin and Son (3868), J. Hart (3873), C. Newsome (3879), J. Ratliff and Son (3884), J. Thorp (3896).**

The great seat of the ribbon manufacture in England is Coventry: a large assortment of Coventry ribbons is exhibited, some having elegant floral designs, others more curious than beautiful, having likenesses woven into them, or mottoes and verses : on some wide ribbon is designed the legend of the Lady Godiva. Although such beautiful ribbons are manufactured in our own country, the demand here for French goods far exceeds that of the English, but, *vice versá*, the French prefer our ribbons to their own.

CLASS XIX.—FLAX AND HEMP.

Number of Exhibitors, 82.

SITUATION OF CLASS.—*South Gallery, running against the wall of the Picture Gallery, towards the South-east Transept.*

Flax (which is largely cultivated for its fibre and seed, and, next to cotton, is the most extensively-used raw material for textile manufacture in the vegetable kingdom) was primarily a native of Asia, and was introduced at an early period into Europe.

Hemp is a commoner kind of flax, which is greatly used in the manufacture of huckaback, for towels and common tablecloths, also in the common material worn by agricultural labourers; but one of its greatest uses is in the making of twine and rope: some beautiful specimens of each may be seen in this Class.

Jute is another variety, consisting of the fibres of two plants, called the Couch and Isbund; it is much used in the manufacture of carpets, rugs, mats, &c., as it has much the appearance of worsted. The chief seat of this manufacture is at Dundee, from which place a great variety of articles have been sent for exhibition.

The produce of flax is various, as, in the first place, it yields that valuable portion termed "flax" in commerce; 2nd, the woody refuse, used as fuel; 3rd, tow, which is the short, broken fibres; and, 4th, oil-cake, and linseed-oil, which is produced from the seed by crushing it.

At the present day the flax-plant is grown for the fibre alone, the seed alone, or for both products together, in many countries of the eastern, and in some of the western hemisphere. For seed alone, in Hindostan, Turkey, and the United States of America; for fibre and seed, in Russia, Belgium, Holland, France, Germany, Scandinavia, Italy, Switzerland, the Iberian Peninsula, Great Britain, and Egypt. In Ireland, chiefly for the fibre, without utilizing the seed. Russian, Dutch, American, and home-grown seed is used in Ireland: there no manure is required. When the plant is a few inches high, weeds are carefully removed, and no further attention is necessary till the season of "pulling," that is, pulling it up by the roots. After pulling, the flax is steeped, to separate the fibre: this is done in various ways in ponds and rivers. The most celebrated steep water in the world is the river Lys, which rises in the north of France, flows through the west of Belgium, joining the Escant at Ghent. Flax is sometimes used without steeping, but then generally only for tarpauling, rick-covers, ropes, &c., where pitch or tar is employed to prevent the decomposing action of moisture and of atmospheric changes.

As the steeping of flax in rivers, &c., is a long, tedious process, several systems have been invented and tried; but the most generally used is a system, invented by Mr. Schneck, and introduced into Ireland in 1847. After steeping, the fibre is then dried, which may be done in various ways, after which the process termed scutching is applied, that is, separating the fibre from the woody matter of the stem; the next process is to give the flax repeated blows, in a machine termed a bracé, or braque. Scutch-mills have been greatly improved during late years, and, unless in remote districts, are always used. The "heckling" then has to be done, which is the last operation the flax has to undergo before reaching the spinner. We will not enter into the process, as it has been described under the Spinning-machines already referred to.

The weaver, by slightly different processes in the order of weaving, manufactures the flax into materials bearing many different names, some of which, as that, hold a place in this Class, must be briefly described. The exhibition of the linen manufactures of Ireland is very excellent; plain linen is there in all qualities and various widths, from the narrowest and coarsest to the widest and finest; the finest are shown in Case 3743; one, which measures only a yard wide, is of the value of 15s. per yard, on account of the quality and fineness of texture.

The Cambrics are also very beautiful, especially in the handkerchiefs. Cambric is a fine, thin kind of linen, which derives its name from Cambray, from whence it was first brought to this country.

The Damasks, which are another variety of manufactured flax, are remarkably beautiful. The term Damask is said to be derived from Damascus, where it was anciently made; it belongs to that species of texture which is distinguished by practical men by the name of tweeling, of which it is the richest pattern. The tweel of damask is usually half that of full satin, and consists of eight leaves, moved either in regular succession or by regular intervals, eight leaves being the smallest number which will admit of alternate tweeling at equal intervals.

Diaper, of which a large quantity is exhibited, is a kind of damask, the difference being only in the tweeling, which is generally five leaf, that is to say, every warp floats under four threads of woof, and is raised, and, of course, interwoven with the fifth. This is done either successively, forming diagonals at 45° upon the cloth, or by intervals of two threads, which is called the broken tweeling.

CLASS XXVII.—ARTICLES OF CLOTHING.

Number of Exhibitors:—

Sub-Class A., 25.	Sub-Class C., 89.
Sub-Class B., 11.	Sub-Class D., 88.

SITUATION OF CLASS.—*In the South-east angle of the Gallery, continuing from Silk and other Textile Fabrics.*

Of hats and caps, which form the Sub-Class A, it is quite unnecessary to say a word. Bonnets and general millinery, Sub-Class B, may be left to speak for themselves. Of ladies' nightcaps, patent dress fastenings, and artificial flowers, the interested visitors will be the best judges.

Sub-Class C—hosiery, gloves, and clothing in general—presents many things of interest. Allen and Jolly, for example, exhibit samples, showing cotton-spinning from the earliest date. Many of the examples of hosiery are well deserving attention.

From the Shetland Isles we have knitted goods, viz., lace shawls and veils of fine white Shetland wool, and also of silk; thick shawls of natural colours for winter wear: white and coloured hose: under clothing, &c. These goods, all knitted, are much prized for the softness and elasticity of their texture. The lace shawls are justly admired for the many beautiful and varied patterns knitted in them. The thick shawls cannot be equalled for comfort, and are much used by invalids and delicate persons. These are exhibited by R. Linklater, of Lerwick, Shetland Isles.

Sub-Class D: in this there is certainly a great variety of boots and shoes, and of the various appliances necessary for the production of an easy covering for the feet.

Of the leather-made boots and shoes it is not necessary to say a word; there are some two or three substitutes, which appear to require a brief notice.

Pannus-Corium, or leather-cloth boots and shoes are exhibited by Hall and Co. The Pannus-Corium is a cotton material prepared with a composition which renders it peculiarly soft and easy to the feet; it resembles the finest leather. The notices given in Vol. I., page 159, of the consolidation of oils, will sufficiently explain this leather-cloth.

Mr. Hutchings is another exhibitor of a somewhat similar article, which he describes as "made of a vegetable material less perishable than leather, more durable, continuing ever limpid and pliant."

India-rubber boots and shoes are exhibited by the North British Rubber Company. Their Case contains one boot of giant size, and Liliputian shoes; but the shoes exhibited are worthy of notice for their beauty of shape, lightness, and cheapness; as is also a shoe for miners and others, working in damp places.

CLASS XXI.—WOOLLEN AND WORSTED, INCLUDING MIXED FABRICS.

Number of Exhibitors, 163.

SITUATION OF CLASS.—*South-east Gallery.*

The condition of this Class, interesting as it is, is such, that little can be said of it in such a book as that which is now placed in the hands of the public. I cannot do better, in support of this statement, than quote the words of a communication from Messrs. Wm. Ecroyd and Sons.

"Beyond the details of our fabrics, which you will find in the 'Illustrated Catalogue,' there seems nothing further to remark, except the fact that all our fabrics, from the heaviest to the most frail in texture, are the productions of the *power-loom*; as well the richest combinations of silk and wool as the cheapest articles made from cotton and wool. The special and distinguishing feature of our business policy has been the adaptation of those great mechanical improvements, and that more perfect organization of labour, which have originated in the Lancashire cotton trade, to the more perfect and economical production of the worsted and mixed fabrics which constitute our staple. We purpose also to exhibit a pattern-book, showing the productions of our firm here about the year 1760."

Woollens.—The fibres of wool, being contorted and elastic, are drawn out and spun by machinery, in some respects similar to that used for cotton, but differing in various particulars. There are two sorts of wool which afford the basis of different fabrics—the *long* wool, or worsted, in which the fibres are rendered parallel by the process of combing, the material of which camlets, bombazines, &c., are made, and the *short* wool, prepared by carding, like cotton, which is used, in different degrees of fineness, for broad-cloths, flannels, and a multitude of other fabrics. This wool, when carded, is formed into small cylindrical rolls, which are joined together, and stretched and spun by a *slubbing* or roving machine, and a jenny or mule, in both of which the spindles are mounted on a carriage, which passes backwards and forwards, so as to stretch the material at the same time that it is twisted. On account of the roughness of the fibres, it is necessary to cover them with oil or grease, to enable them to move freely upon each other during the spinning and weaving.

After the cloth is woven, the oily matter is removed by scouring, in order to restore the roughness to the fibres, preparatory to the subsequent operation of *fulling*. In articles which are made of long wool, the texture is complete when the stuff issues from the loom. The pieces are subsequently dyed, and a gloss is communicated to them by pressing them between heated metallic surfaces; but in cloths made of short wool, the web, when taken from the loom, is loose and open, and requires to be submitted to the operation of *fulling*, by which the fibres are made to felt, and combine more closely. By this process the cloth is reduced in its dimensions, and the beauty and stability of the texture are greatly improved. The tendency to become thickened by fulling is peculiar to wool and hair, and does not exist in the fibres of cotton or flax. It depends on a certain roughness of these animal fibres, which permits motion in one direction while it retards it in another; it thus promotes entanglements of the fibres, which serve to shorten and thicken the woven fabric. Before the cloth is sent to the fulling mill, it is necessary to cleanse it from all the unctuous matter which was applied to prepare the fibres for spinning. The nap, or downy surface of broad-cloths, is raised by a process, which, while it improves the beauty, tends somewhat to diminish the strength, of the texture. It is produced by carding the cloth with a species of burrs, the fruit of the common teasel (*Dipsacus fullonum*), which is cultivated for the purpose. This operation extricates a part of the fibres, and lays them in a parallel direction. The nap, composed of these fibres, is then cut off to an even surface, by the process of *shearing*.

This Class may be grouped in localities.

West of England.—The productions of the West of England claim precedence in many respects, and not the less so, that the display made cannot be said, so far as its extent goes, fairly to represent the productions of that locality.

The *West Riding of Yorkshire* and the adjoining county are well represented. Leeds is distinctly marked by its woollen products; Bradford by its worsted, alpaca, and mohair fabrics; Huddersfield further illustrating the woollen trade, but bringing in a new element in the form of mixed fabrics, and even cotton manufactures of a peculiar class. Halifax, again, is distinct from the others by the artistic elements brought to bear in the damasks, worsted, and mixed fabrics, which characterize the leading features of its display.

The Yorkshire cloths exhibited are very excellent. The novelty, however, of this contribution is a series of the natural coloured wool of the *alpa vicuna*, a species of South American Llama. These are certainly very admirable for softness, lightness, and warmth. The peculiar fabrics in coatings and trouserings, which these exhibitors usually supply to their customers, are all of an excellent character and make. These consist of black cloth of extraordinary fineness and texture, and black doe-skin of equally excellent character.

London.—The cloth merchants of London display a high class of goods; but it must not be forgotten that these are all of them the productions of the districts already named.

The merchant tailors and woolstaplers of London are most important interests; and the exhibition they make, illustrating the command they have of the market, is one of which they may be justly proud.

Scotland may be regarded as being represented by James Johnston, who is an extensive exhibitor of tweeds and mauds, made from Cheviot and Australian wools, shown for their strength, durability, and comfortable wear, and as specially suited for sportsmen; also vicuna cloths and shawls, made from the under-coat of the vicuna deer, a wild animal found only in the Andes of South America. This material is peculiarly soft and silky; but, as the animal has to be killed, and its outer hairy coat separated from the short fine wool beneath, it is difficult to be got, and consequently expensive.

There are several collections of samples of worsted yarns, carded and combed, single and folded, and used in the manufacture of Brussels and tapestry carpets, made by power and hand looms; embroidery and other soft goods, fringes, braids, webs, &c.

Mohair cloth, seal-skin cloth, velvet cloth, and many others are largely exhibited. These may be regarded as the curiosities of this Class. They are to some extent described under the head of Velvet Fabrics.

Ireland is fairly represented. Irish poplins are exhibited by Pim Brothers and Co. This is a mixed fabric. The warp consisting of silk of superior quality; the weft spun from the finest wool. The beauty of its texture has been much increased during the last ten years, principally owing to the great improvement in the spinning of woollen yarns. The specimens exhibited are—

Single poplins.
Double (plain) do.
Do. (watered) do.
Terry do.
Tartan plaid do.
Bayadore poplins.
Ottoman do.
Figured do.
Brocaded do.
Tissue do.

Of these, the single poplin is that of which the largest quantity is manufactured; this quality being the least expensive, and at the same time remarkable for its durability in wear, and for the richness of its appearance.

The tartan poplin is also manufactured to a large extent. The varied and beautiful patterns of the Scottish clans show to the greatest advantage in this article.

The double and terry poplins are remarkable for their richness and beauty, and, as a dress, cannot be equalled.

We would direct particular attention to a *new* description of *brocaded* poplin, manufactured expressly for the Exhibition. It consists of a double figure; one raised from the warp, the other made by silk weft, used in addition to the woollen yarn. Formerly, in producing brocades of this description, the portion of silk weft not required in the pattern remained on the back, or wrong side; whereas, by the new method, it is interwoven with the warp, adding thereby to the richness and durability of the article It is also important to add, that the cost of the material will be considerably less than the old style.

Class XXII.—Carpets.

Number of Exhibitors, 43.

Situation of Class.—*Under North-east Gallery, and on Gallery Walls.*

This Class includes the woven and felted carpet, and the painted floor-cloth. There are two systems of carpet manufacture, that of double fabrics, and that cut in imitation of velvet. In a Brussels carpet the worsted yarn, raised to form the pile and make the figure, is not cut; in the Wilton the pile is cut to give it a velvety aspect and softness. In the Imperial Brussels carpet the figure is raised above the ground, and its pile is cut, but the ground is uncut; and in the Royal Wilton the pile is both raised higher than in the common Wilton, and it is cut, whereby it has a rich cushion-like appearance. The cloth of all these superior carpets consists of woollen and linen, or hemp, the latter being put upon a beam, and brought, of course, through heddles and a reed; but as its only purpose is to bind together the worsted fabric, it should not be visible upon the upper face of the carpet. The worsted yarn is wound upon small bobbins or pirns, with a weight affixed to each, for giving proper tension to the threads. Their number varies, for one web, from 1300 to 1800, according as the carpet is to be 27 or 36 inches wide, and they are placed in frames behind the loom, filled with differently-coloured yarn, to correspond with the figure. This worsted warp is then drawn through the harness, heddles, and reed, to be associated with the linen yarn in the compound fabric.

In Kidderminster carpeting both warp and weft appear upon the face of the cloth, whereas, in the Brussels style, only the warp is seen, its binding weft being five hempen or linen threads. The three-ply imperial carpet, called Scotch, is coming very much into vogue, and is reckoned by many to be little inferior in texture, look, and wear to the Brussels. Kilmarnock has acquired merited distinction by this ingenious industry. In this fabric, as well as in the two-ply Kidderminster, the weft predominates, and displays the design; but in the French carpets the worsted warp of the web shows the figure. Plain Venetian carpets, as used for stairs and passages, are woven in simple looms, provided merely with common heddles and reed. The warp should be a substance of worsted yarn, so heavy as to cover in the weft completely from the view.

Figured Venetian carpets are woven in the two-ply Kidderminster looms, and are provided with a mechanism to raise the pattern upon the worsted warp. The weft is an alternate shool of worsted and linen yarn.

With these remarks we must leave the carpets to be admired or otherwise, as they prove to be examples of good or bad taste. It is grievous to notice so many which must certainly fall under the latter class.

The floor-cloths present few features of novelty. The most successful appear to be those exhibited by John Hare and Co. These are—a reproduction and perfect copy of the "Corinium" Roman tesselated pavement, discovered some years since at Cirencester, and considered one of the most beautiful in Europe: a composition of encaustic tiles, with borders, and in the centre the arms and badges with crests of England, Scotland, Wales, and Ireland: a composition of inlaid marble, with borders, and Mosaic border at top and bottom.

CLASS XXXVI.—TOILET, TRAVELLING, AND MISCELLANEOUS ARTICLES.

Number of Exhibitors, 30.

SITUATION OF CLASS.—*Gallery, North Court, at the head of the Stairs from the Music Court, near the Horticultural Entrance.*

SUB-CLASS A.—DRESSING-CASES AND TOILET ARTICLES.

Exhibitors.—C. Asprey, T. and G. Austin, G. Betjemenn and Sons, E. Bourn, Gerhardt, Rothman and Co., Howell, James and Co., Jenner and Knewstub, C. F. Leake, W. Leuchars, Mappin Brothers, Mappin and Co., Parkins and Gotto, Toulmin and Gale, F. West—(6926 to 6940).

There are exhibited by Mechi, Asprey, and West, in cases on the Dais under the Eastern Dome, a collection of beautiful and costly dressing-cases for ladies and gentlemen. These are of morocco leather, elaborately inlaid with pierced metal, and richly engraved work, carvings in ivory, with interior fittings of gold, silver-gilt, and silver. Despatch boxes and travelling bags are equally convenient and handsome. One thing alone can be particularised, that is, an antique writing-table, set in ebony and solid silver, exhibited by Mechi: the design is taken chiefly from work of the 14th and 15th century, or from drawings by Holbein, for the jewellers of the court of Henry VIII. contemporary with Francis I. of France. An attempt has been made in this group to illustrate the principal ideas of the artists of the mediæval period, and make them subservient to the requirements of modern luxury and over-refinement.

Exhibited in a glass case in the Nave will be found some articles in fine taste, by Spiers and Son, of Oxford. These consist of the following articles amidst many other things:—

A set of writing-table furniture, in richly gilt ormolu, inlaid with porcelain medallions enamelled by the painters of the Queen's new dessert service, and in the same style, comprising seventeen articles, *en suite.*

A lady's dressing-case in dressed shagreen, with gilt mounts. The interior lined with polished shagreen and Genoa silk velvet; containing diamond cut-glass fittings, with silver mounts gilt and enamelled in the moresque style, and gold initial plates; cutlery and other instruments in silver-gilt handles to correspond; brushes in polished shagreen handles; mirror in gilt and enamelled frame on a new plan; and drawer fitted for jewellery, with secret divisions for gold, notes, &c. There is also a Tazza in ormolu, of Etruscan form and ornament, inlaid with a porcelain plaque, enamelled in dark blue in the Limoges style, which is very beautiful.

SUB-CLASS B.—TRUNKS AND TRAVELLING APPARATUS.

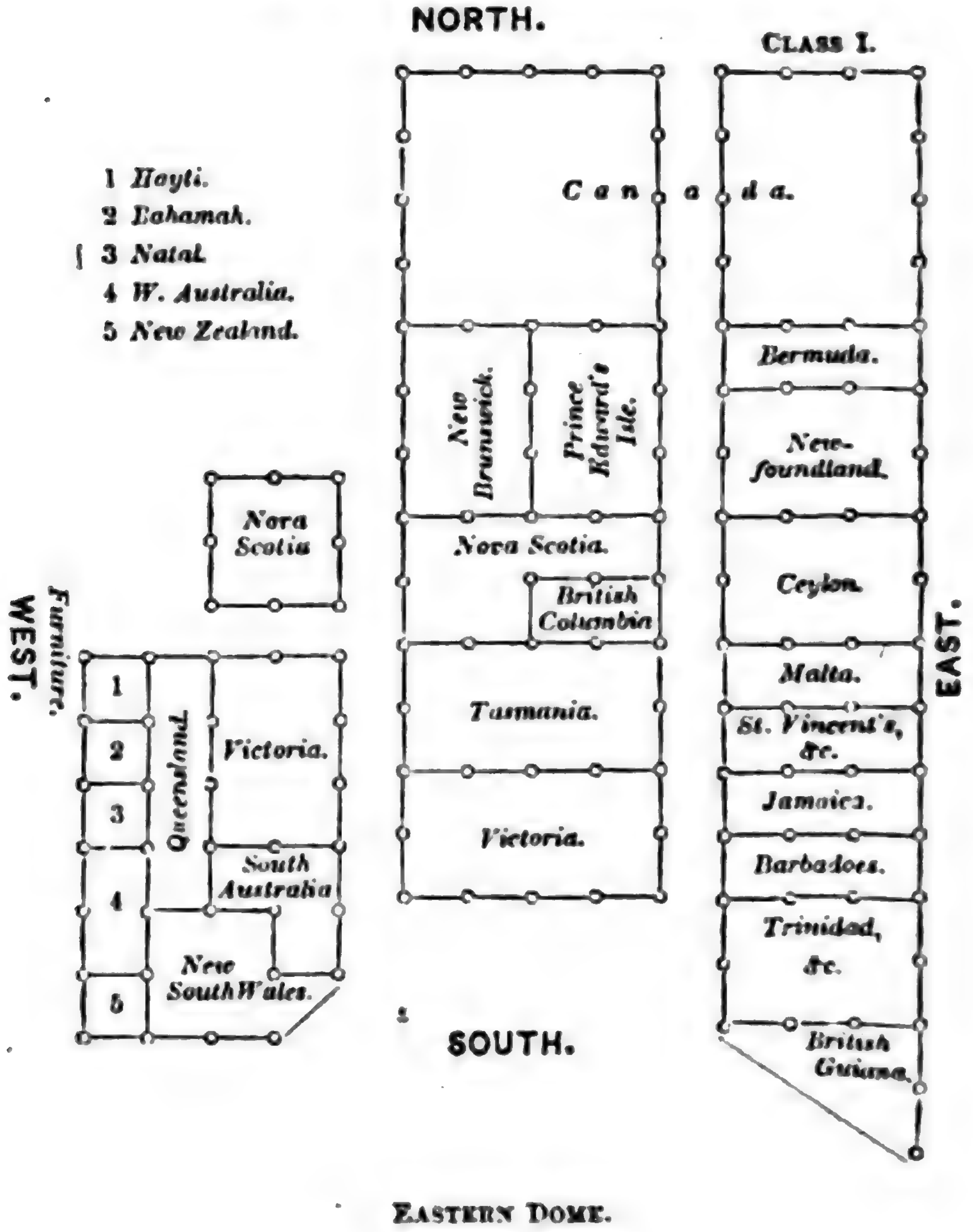
Exhibitors.—**J. W. Allen, B. Barrett, Brothers, T. Bourne, Jane H. Cave, W. Day and Son, S. Fisher, Harrow and Son, G. Kane, J. Last, S. Last, H. Pratt, S. W. Silver, J. Southgate, C. Watson, E. Wilks—(6951 to 6965).**

Portmanteaus, dress and bonnet baskets, leather bags, and imperial trunks, will not allow of description. There are a few select exhibitors; these, of course, have selected their best articles. Hence all are good, and all are convenient. The requisites of travel appear to be well cared for.

Colonial Possessions.

Situation in the Building.—*The Colonies occupy the North-eastern Transept. They extend for a short distance on the North side of the Nave, India having her collection in the Gallery.*

Plan of the Colonial Courts.



AUSTRALIAN COLONIES.

The Australian colonies occupy prominent places in the International Exhibition. At the principal entrance in the Eastern Dome the gold pyramid from Victoria greets the visitor, and shows the exact bulk of gold produced in that colony since the last Exhibition, nearly 800 tons; valued at 104,649,728*l.* It is a pyramid 44¾ feet high, and 10 feet square at the base; and no other country in the world could show a similar amount of productiveness in the precious metals. In the East Transept, again, Tasmania invites attention by an attractive timber trophy. Both New South Wales and New Zealand occupy places of honour, having a frontage in the Nave; South Australia, and Queensland, and Western Australia are also well placed in the building, and we are glad to perceive that the contents of the courts are attracting a very large number of the visitors; and the result of their examination of the many rich products here displayed cannot fail to be highly advantageous to the respective colonies.

The British visitor seldom takes stock of the colonial possessions of the Empire, and the condition of these as regards their progress is usually roughly estimated rather by current facts and figures than by any careful comparison of the present and the past, from products exhibited. The material wealth of the world and the influences of commerce and civilization progress so rapidly, that a backward glance of some years into the past creates surprise even in the most unreflecting mind. What amazing strides have the colonies, individually and collectively, made in the last ten years!—an advance in every element of prosperity certainly unequalled in any other quarter.

The population of the Australian colonies has more than doubled in the decade, the chief addition being made by more than half a million of emigrants from the United Kingdom. The progressive increase of the population has been great in all the colonies; but Victoria, from the influence of its gold fields, shows the largest increase, having advanced from 77,345 souls in 1850, to 530,262 in 1859. Some important territorial changes have taken place in Australia since 1851, which require preliminary notice. The settlement of Port Phillip, which had, in 1851, only just been created into a separate colony, has now become the principal colony of the group.

The northern portion of New South Wales, formerly known as Moreton Bay, has, within the last two years, been separated, and made an independent colony, under the name of Queensland; and by the energy of its governor and leading men is making great strides in progress, and attracting a large share of notice at home. Norfolk Island, formerly a convict settlement and dependency of New South Wales, has been colonized by the Pitcairn Islanders, about two hundred in number, to whom a romantic interest attaches, as the descendants of the mutineers of the *Bounty*, and who had kept up their primitive simplicity and isolation, until they had outgrown the limits of their former island home. Van Diemen's Land, having ceased to be a convict colony, has changed its name to Tasmania—certainly a more euphonious title. In New Zealand, Canterbury and several other new settlements have been founded, and many new provinces created.

The land under cultivation in Australia has more than doubled in the ten years; and it is satisfactory to find that the greatest progress in this respect has been made in Victoria, notwithstanding the general attractions of the gold fields. This colony bids fair, before long, to be self-supporting, in an agricultural point of view, as regards grain, forage, and root-crops, for which it has hitherto drawn largely upon the surrounding colonies. The live-stock in the colonies have also about doubled, with the exception of sheep, which have increased more slowly. There are two causes for this—the larger demand for slaughter, owing to the increased population, and the deficiency of shepherds and pastoral labour generally. The clip of wool has, however, by no means declined; on the contrary, there is an advance of nearly 50 per cent. in the shipments in the last ten years, of which more than one-third is exported by Victoria.

Another most important Australian product is its gold; and this, though chiefly concentrated in Victoria, is also obtained in smaller quantities in four of the other colonies. It is computed, on good authority, that within the last ten years more than 120,000,000*l.* sterling of gold has been obtained in Australia. To these gold discoveries Australia owes much of her existing prosperity and population.

The following is a summary of the awards granted to the Australasian colonies:—

	Medals.	Hon. Mention.
New South Wales - - -	76	51
Victoria - - - - -	111	84
Queensland - - - -	26	20
South Australia - - - -	24	11
Western Australia - - -	14	12
Tasmania - - - - -	26	26
New Zealand - - - -	33	10
	310	214

SOUTH AUSTRALIA.

Number of Exhibitors, 77.

SITUATION OF CLASS.—*North-east Transept, West Side, at the corner of the Eastern Dome, between New South Wales and Victoria.*

The mineral collection from this, the second in point of time of our Australian colonies, is well marked in the International Exhibition by its copper ores. The exhibitors of minerals are: *The English and Australian Copper Company, The South Australian Mining Association, Wheal Ellen Mining Company, Cumberland Mining Company, Great Northern Mining Company, Wallaroo Mining Company, Wirra Wilka Mining Company, Worthing Mining Company, Preaminna Mining Company, Duryea Mining Company, Kapunda Mining Company, Mount Rose Mine*, and the *Cornwall Mining Company*, who exhibit a block of ore weighing 6 tons, which serves to illustrate the peculiar character of these mineral formations. Then there are individual exhibitors, Dr. Englehart, Dr. Mauran, Mr. Rollison, R. V. Rodda, J. Kellet, and R. S. Crabb. Mr. Graham, whose name does not appear in the catalogue of the International Exhibition, being the exhibitor of the fine malachite table, at the entrance of the court from the Transept. A brief account of those mines sending examples of their produce is all that can be given.

Burra-Burra Mines.—These remarkable mines were first worked in 1845, and they are an extraordinary example of successful mining speculation. On the 5th of September, 1845, a few tradesmen in Adelaide subscribed 12,320*l.*, with which the works were commenced. The first returns were as follows:—

		Tons.	Cwt.	
September 30th,	1846 – – –	6,359	10	copper ore.
„	1847 – – –	10,794	17	„
„	1848 – – –	12,791	11	„
„	1849 – – –	7,789	16	„
„	1850 – – –	16,692	9	„
Making a total in 5 years of – –		56,428	2	„

varying in quality from ore containing 30 per cent. of copper to much that produces 70 per cent. of that metal. The money value of this is 738,108*l.*

In 1851, the discovery of gold in the neighbouring colonies of New South Wales and Victoria, attracted all classes, and more especially miners, from their usual occupations, and the number of hands employed at the mines was reduced from 1,042 to 100. Eventually the pumping engines were stopped and the mine allowed to fill with water. It was not until January, 1855, that work was resumed. With increasing depth, the cost of production of course increases, and the margin of profit is lessened. There does not appear, however, to be any falling off in the supply of ore, and the operations of the mine have proceeded with undiminished activity, with a vast amount of benefit to the colony at large, and with satisfactory profits to the proprietors. The annual yield of ore, for many years past, has averaged from 10,000 to 13,000 tons, of from 22 to 23 per cent. of copper; in round numbers, about 2,500 tons of metallic copper, worth, to the colony, at the least, 225,000*l.* per annum. The direct expenditure of the concern within the province since its commencement amounts to 1,640,000*l.*, of which upwards of 1,000,000*l.* has been expended in wages alone.

The gross profit stands at 836,000*l.*, of which 677,600*l.* has been divided among the shareholders, 147,840*l.* added to the capital stock, and 10,560*l.* remains undivided. The greatest number of hands employed was during the year 1859, when it amounted to 1,170 individuals. The wages paid to the workmen, of course, vary according to the state of the labour market. Common labourers' wages have fluctuated from 25*s.* to 40*s.* per week; miners, from 35*s.* to 60*s.* per week—tributers making very much more occasionally; mechanics, from 42*s.* to 112*s.* per week.

This great mineral deposit exhibits some peculiarities. Although the miners and the proprietors speak of working on lodes, these are of a very different character from the copper lodes of the primary rocks of this country. In a great basin, formed in an amphitheatre of hills, an immense deposit of clay—the result of the decomposition of the clay-slate—has taken place: this, under conditions which we are not enabled to determine, became also the reservoir for the reception of copper. In all probability it was first deposited in the pure metallic state—a fine example of the electrotype process of Nature. During this process, the so-called veins spread themselves through the soft clay in various directions, in precisely the same manner as we may, by carrying the terminal wires of a voltaic battery into a mass of clay saturated with sulphate of copper, form a curious arborescent mass. By the action of the oxygen contained in the water, this copper becomes oxidized by the slow process which gives rise to the very beautiful crystals of red oxide of copper, and from this state it passes into the blue and green carbonates, under the action of carbonic acid, the difference in the colour of the two arising from the quantity of water in combination.

The malachites, which are extensively employed for ornamental purposes, and of which the table forms a fine example, are carbonates of copper; and specimens selected from the Burra-Burra mines are sold for this purpose.

The Kapunda Mines are situated in the county of Light, about fifty miles north-east of Adelaide. They were first discovered in the year 1843, by Chas. Samuel Bagot, Esq., now of London, also by Francis Stacker Dutton, Esq. The ore was cropping out on the surface, and was discovered during a search for some straying sheep. The land was then unsurveyed, and the property of the Crown, forming a part of Captain Bagot's sheep-run.

The workings have been continued, with a few intermissions, until the present time.

The ores comprise almost every variety, as yellow ore or pyrites, blue and green carbonates, muriates, grey and black sulphides, oxides, bell-metal and peacock ores, and native copper, or malleable. The percentage, also, varies much, from 66 downwards.

All the ores raised are now reduced to fine copper before shipment: 595 tons were shipped in 1861. The expenditure during the year being 48,300*l.*; the greater portion of which is circulated on the spot for wages, fuel, &c.: 8,713*l.* was paid for fuel for the smelting works; timber being alone used.

Wallaroo Mines.—The most prolific mines yet opened are not more than six miles from Wallaroo Bay, from which they took their name, and the character of the country rendered cartage peculiarly light and easy. How far inland over the surface of Yorke's Peninsula the valuable lodes run is still uncertain; but even if all the 27,000 acres of mineral claims, which cover so large a space on our land office maps, were to prove available, the greatest distance of land carriage to which the ore would be exposed would be about fifteen miles—the average width of the entire peninsula not exceeding twice that distance.

At the various workings of the Wallaroo mines, the total quantity of ore raised, up to the 31st January, 1861, was 11,370 tons—of which 5,370 have been shipped to Melbourne and Sydney; about 6,000 tons remaining at the mines and at the Wallaroo Smelting Works. These works at present include ten reducing furnaces and three refineries; and ten extra reducing furnaces are in process of erection. The ores have averaged from 15 to 25 per cent. in richness. Altogether there are about 400 men directly employed at these workings; besides which there are about ninety men employed by the same proprietary at their smelting works at Wallaroo, which are not, however, as yet in full operation. The average wages of miners at these mines are, from 45*s.* to 60*s.* per week. Ordinary labourers earn 35*s.* per week. Two steam-engines, of a united power of about 180 horses, are already employed here, and three more, of a united power of 195 horses, have been ordered in addition.

The works of the *Cornwall Mining Company* are the next of importance. Arrangements have just been completed to erect ore-reducing works at the New Cornwall Mines. At these works the ore will be treated by a process recently patented by Mr. R. V. Rodda. The ore is converted into metallic copper before dressing. Specimens illustrating the process have been forwarded to the International Exhibition.

The workings of the *Duryea Mining Company* are situated about three miles to the southward of Kadina, and a considerable expenditure has already taken place upon the ground.

The company commenced work at Wallaroo, and at 18 feet below the surface found green carbonate of copper. At 21 feet below surface drives were made in various directions, in each, copper was cut, all dipping down. At about 25 feet, water was cut.

Another shaft (the Duryea) was then commenced, and at 10 fathoms 3 feet a fine course of mundic with black quartz was cut, and underlying, a fine lode of black ore was cut, 7 feet to 8 feet 6 inches thick, dipping down to the south. Specimens of this ore were assayed, and found to contain 64 per cent. of copper. The water making very freely, a fine high-pressure horizontal engine was erected, and an engine-shaft has been sunk to the depth of 15 fathoms. At 12 fathoms a drive was made from the Duryea shaft to the engine-shaft, in which two winzes have been sunk, one 9 fathoms and the other 4 fathoms. From these winzes rich black ore has been raised, yielding from 52 to 57½ per cent. of copper. Specimens of all these ores are exhibited.

Several mines have been opened "in the far north"—that is, in the tract of country north of Port Augusta—but though several of them are of high promise, want of capital, and the difficulty of getting the ore down to the shipping-place, till better means of transit are supplied, have caused the suspension of almost all mining operations in that direction, with the exception of those carried on by the *Great Northern Mining Company*, who exhibit.

This company is composed of an English proprietary, whose property consists of eleven mineral leases, about 290 miles to the north of Port Augusta. The management is by a London board of directors, with a committee of management in Adelaide. The subscribed capital is 160,000*l*., of which 80,000*l*. are paid up. The working operations of the company in the colony commenced in June, 1860, and have been prosecuted with considerable vigour and success. The operations have hitherto been carried on without the aid of machinery; but it is now found requisite to erect a steam-engine, whims, and ore-crushers, which, it is calculated, will be completed in May, and tend greatly to increase the produce of the mines.

The committee have shipped to England 600 tons of ore, and have now in course of shipment 90 to 100 tons. The character of the ores hitherto sent away has been that of the usual carbonates and grey ores, giving a high produce, say from 27 to 30, and some as high as 40 per cent.

Near Strathalbyn several mines producing copper and lead were opened many years since, and considerable returns made from them. More recently the Wheal Ellen Mine, in the same locality, producing lead, silver, copper, with gold in the gossans, has commenced. Carbonate of lead, galena, and a pig of lead, produced by the smelting works on the mine, are exhibited.

The following are the characteristic specimens from these mines:—Red oxide of copper. Green carbonate of copper. Blue carbonate of copper. Red oxide and carbonate combined. Red oxide and blue carbonate. Strata in which the minerals occur. Native copper. Malachite and red oxide of copper. Fibrous malachite. Cabinet specimens of these are arranged in the glass case in great numbers. The specimens of malachite, and of purple carbonate of copper, are very remarkable natural productions.

Beyond these, the galena and carbonate of lead show the importance of this mineral colony.

VEGETABLE PRODUCTS.

Wheat.—For some time after the foundation of the colony, it was gravely alleged by many people that the country was altogether unadapted to the growth of wheat. At the Great Exhibition of 1851, South Australia took the prize for having grown the finest wheat in the world, and thousands of acres are now annually devoted to the production of this grain. The contest between New South Wales and South Australia on the present occasion was a keen and close one, but was won by the latter colony; the respective weights being, New South Wales, 68 lbs., South Australia, 68 lbs. 1 oz., to the bushel. The South Australian wheats are generally admitted to be beautiful samples, they carried off five prize medals, and one was given for flour. Mr. Dugald Campbell has made an analysis of an average of twelve samples of wheat, and of eight samples of South Australian flour, shown in the International Exhibition. The average weight of wheat was 65¾ lbs. The per-centage of flour was 83·5, and of bran 16·5. From containing only this small quantity of bran, it is a necessary conclusion that this wheat will yield a higher per-centage of the finer flours, when ground and dressed in the usual manner, than wheats having a higher per-centage of bran. The moisture or water in the wheat when dried at 212° Fahr. is only 12·57 per cent., whereas in wheat of this country it varies according to season and other causes from about 15 to 20 per cent. The dry matter, in which are included the nitrogen and ash, is 87·43 per cent. The nitrogen in the wheat when deprived of moisture amounts to 2·08 per cent., and in its ordinary state to 1·91 per cent. This represents in the one case 12·96 per cent., and in the other 11·28 per cent. of gluten and albumen.

The South Australian has therefore much the advantage over the English wheats, but in some points more than others. Oats and barley also received honourable mention.

Wine.—As the eldest colony, New South Wales took the lead in vine-growing, and produced samples which have been brought into comparison with first-class wines in Europe, and have stood the test of that ordeal. Adelaide, following in the wake of the elder colony, has imported thence the varieties of grapes there found suited to the Australian climates, as well as the best kinds grown in Spain. The greatest obstacles which the South Australian vine-growers have had to contend with, in extending their vineyards, has been the abstraction of nearly all the available labour in the colony by the gold diggings in Victoria and New South Wales.

In the cellars of the best vine-growers, may be tasted samples equal to any wines of their class to be found in any part of the world.

We may particularly instance a pure Riesling wine, made by Mr. Joseph Gilbert, at Pensey Vale, and a red wine resembling Burgundy, the produce of the same vineyard, of which he has, we believe, samples from every vintage since 1852; also a pure Riesling wine, and an Españoir and a Muscatel, made by Mr. Henry Evans at Evandale; a Shiraz and Donzelino, a superior claret, and an excellent Verdeillo, made by Mr. Patrick Auld at the Auldana vineyard; and a particular delicate, fragrant, and grateful wine, something between port and sauterne, made by Mr. Picton at the Clarendon vineyard. Mr. Waterhouse at Highescombe, on an elevated site among the hills near the sources of the Torrens, makes a red wine resembling Burgundy, which has a high reputation in the colony. Samples of the above-named wines, as well as many others, are shown in the International Exhibition.

South Australia carried off four medals for wines, against seven given to New South Wales, and one to Western Australia.

The capabilities of the colony are further shown by Muscatel raisins, almonds, dried apricots, jams, biscuits, and a small collection of native woods. There are some stuffed birds, insects, and other objects of natural history. South Australia is a large wool-producing colony, as there are about 3,000,000 head of sheep pastured there, but there are only six or eight exhibitors. The most important samples are fleeces sent by Messrs. W. Peacock and Sons and Mr. J. Burnett. Mr. J. F. Haigh exhibits six fleeces of Angora and Alpaca wool, from animals reared by him in the colony.

WESTERN AUSTRALIA.

Number of Exhibitors, 68.

SITUATION IN BUILDING.—*The Western Australian collection will be found to the North-West of the Eastern Dome, and between those of New Zealand and Natal.*

The Colony of Western Australia, as defined by Her Majesty's Commission, includes all that portion of New Holland situated to the westward of 129° E. longitude; its greatest length is, therefore, 1280 miles from north to south, and 800 miles from east to west. The city of Perth is situated in latitude 32° south.

The mineral productions of the colony claim our first attention. The specimens of copper and lead ore from Wanerenooka, Wheal Fortune, Wheal Arrino, and Geraldine mines appear to prove the existence of an important mining district.

Wanerenooka copper-mine has already furnished upwards of 1,450 tons of copper-ore, which has realised nearly 20,000*l.*

The last sales of ore were at Swansea in April last, and realised an average of 22*l.* per ton for ore of 22 per cent.

The country is well adapted for mining speculations. It is well watered, and there is sufficient firing to last for many years. There is an abundance of clay fit for bricks. Limestone in the vicinity of the company's property is also procurable.

Wheal Fortune Copper Mine.—The names of the mines in our colonies are not unfrequently derived from familiar mines in this country. Hence it is that we find corruptions repeated at the Antipodes which have unfortunately been admitted at home.

Wheal is a very common prefix to the names of Cornish mines. In old Cornish *Huel* signified a pit or a mine. This became confounded with the Anglo-Saxon *Weal*, for wealth or well-doing, and hence eventually the word *wheal* now used; so that in the above name we have the indication of its being a mine at the beginning, and most improperly repeated at the end. It is a curious fact that in many of the non-metalliferous districts of this country, the term wheal has led people to suppose it meant a mine worked with a wheel.

The above mine was first opened in the beginning of the year 1859, the grant of land on which it is situated in the Victoria district originally belonging to five shareholders, who subscribed a capital of 1,500*l.* for the purchase of the land, and to ascertain its mineral worth,—both lead and copper ores being supposed to exist in large quantities.

The quantity of ore sold in England from this mine up to the present time has been 550 tons of copper and 160 tons of lead ore; the net proceeds of which, as shown by the accounts rendered, have amounted to 9,195*l.*, after paying freight, insurance, commission, and other expenses.

Wheal Arrino is situated on the Upper Irwin, about forty miles from a shipping port at the mouth of the Irwin River. It was discovered in the year 1860, and purchased by the present proprietors. The appearances of this mine give great indications of its being a very extensive deposit of rich ore. The specimen sent is from the surface, and is said to be traced without breaking the ground 600 feet long, and 8 feet wide, and the lode is visible for several miles. The colonial authorities inform us the country is rich and grassy, and abounds with fine timber, well adapted for all mining purposes.

Geraldine lead and copper mines are situated on a bend of the Murchison River, Western Australia. These mines are in a direct line about thirty-six miles from their shipping port—Port Gregory. The lead mines only have been worked to any extent; the copper only sufficiently so to prove that good ore exists in several parts of the property. The lead lode, called the Champion lode, has been traced and opened on upwards of 300 fathoms, and small winzes sunk on the lode at various parts, out of which large quantities of ore have been taken, varying in richness from 70 to 86 per cent. of pure lead. One or two small shipments of the ore have been sent to England on trial; the last one of 64 tons averaged 76½ per cent. of pure lead, and sold for 13*l*. per ton for the lead alone. With these few exceptions, the ore has been roughly smelted on the spot, and disposed of in the Singapore and Batavia markets to the Chinese, who buy it in the pig for rolling thin for lining tea-chests. The prices have varied from 25*l*. to 32*l*. per ton; and the lead always commands a preference in the market on account of its extreme ductility.

Iron ores have been contributed to this collection from Albany and Bunbury, these partaking of the same character as the black metallic sand of Taranaki. Magnetic iron ore is sent from Cotes on the Northam Road, about thirty miles east of Perth. The Royal Engineer Department of Freemantle send a bar of iron, reduced from magnetic iron ore, found on the Northam Road. This bar was proved in conjunction with one of iron of commerce, and with one of Swedish—both the latter being reduced from flat iron in order to assimilate them. The result was a deflexion of about five to eight in favour of the Western Australian iron.

The—so-called—porcelain clay should rather be named potter's clay. It may however prove to be the clay of decomposed granite, though its appearance is rather that of clay slate. The crucible exhibited as made from it seems to be of good quality.

Wilgi is sent by the Central Committee from Perth. They say of it—wilgi, an ochrish clay, which, when burned in the fire, turns to a bright brick-dust colour. With this, either in a dry powdered state, or saturated with grease, the aborigines, both men and women, are fond of rubbing themselves over. In fact, no native considers himself properly attired unless well clothed with grease and wilgi. It is supposed to be a valuable pigment.

Amongst the rocks an asbestiform variety is sent; of this the exhibitor writes:—I send you, for exhibition purposes, specimens of a curious formation of rock in which *asbestos* forms an ingredient. The principal part of the rock looks like *steatite*. It is so soft, that it may be cut into any shape with an axe; but soft as it is, it seems to undergo as little change from the weather as granite or whinstone. This may prove to be a very useful discovery.

The native weapons exhibited will excite much curiosity; few only can be particularized.

Gidji-man-gow.—These are made of different spearwood from the hills, south, and that found in swamps. The barb is made of a piece of scraped spearwood tied on with sinew, and cemented with prepared resin of the xanthorrea.

Gidji-boryle, *Gidji Jeil-Carra.*—The name is also applicable to quartz-headed spears. These glass-headed spears have of course only come into use since the whites landed in the colony, and for warfare are generally preferred by the natives of all districts to the quartz-headed ones. Spears with quartz heads (as above named). Moore writes, speaking of Booryle quartz:—"From the similarity in the appearance, particularly of the fragments of the two substances, it has come to mean glass—as Booryle-Gidji, a spear, the head of which is armed with jagged broken pieces of quartz or glass glued on to the wood. This is a most formidable, and even deadly weapon; the cut inflicted by it is that of a coarse saw, and as it severs the veins and arteries, it is much more dreaded than the barbed spear, which only forces its way without cutting laterally."

Gidji-man-gar.—The shaft is slender and tapering; a formidable and deadly weapon, it is projected by means of the *mois*, or throwing-board, which is also the method used for others.

Gidji Djmjing.—These are sometimes plain, or quartz, or glass-headed, according to where the tribe lives. The children in most cases soon become expert in throwing them, but only from the hand.

Kylis.—A flat curved throwing weapon, made plain on one side and slightly convex on the other; with one end rather longer from the bend or curve than the other. It is held by the longer handle, and on stiff soils is thrown so as to strike the ground with one end about ten or twelve yards from the thrower, whence it rebounds into the air with a rapid rotatory motion, and after having performed a long circumgyration, frequently in two circles, or like the figure 8, it returns nearly to the spot whence it was thrown. It seems to be as much a weapon for treachery as of direct attack. When the eye is diverted by its motions, the opportunity is taken to strike with the spear. They are much valued by the natives, and not readily parted with.

Dowak D-yuna, a short heavy stick used by the natives in close war and capturing game, is thrown with great dexterity, and then easily breaks a kangaroo's leg. It is made of different woods, according to the district.

In the Canning district, the Dowak is sometimes called "Wan-gou-Dowak," as native characters are marked on it, and sent as challenges to another tribe, who cause a reply to be marked on the same, and it eventually brings about either a reconciliation, quarrel, or war. The native carrying it, should he get tired in his own district, gives it over to the first native he meets of his own tribe, who, under penalty of being speared, must see it either forwarded or carry it himself to its destination, and arrange for its return.

There are exhibited several specimens of the *Nivio*, used for launching the spear, about 2 feet long, and about 4 or 8 inches broad in the middle, and tapering off at each end. At one end, which is the handle, is sometimes fixed in the kadjo, or gum, a kangaroo tooth, quartz, or glass, to scrape and point spears with. The other end has a small point or hook resting on the flat side, and which is shipped into a hole at the end of the spear. This is a lever of great power. It is generally made of the wood of the raspberry-jam tree.

This colony has not made so good a display of vegetable and animal products as it might have done. Some collections of furs and dressed skins, feathers and feather ornaments, shells, work and chess tables of inlaid native woods, a pretty cabinet, native weapons, barks and fibres, are shown. The bark of the tea-tree, a species of Mealleuca, easily reducible to a pulp, is recommended as a paper material. Although cotton is not shown, a Western Australian Cotton Company, with a large capital, has been formed in London.

Mr. J. G. Carr exhibits gum and resins from the Manna-tree, a species of acacia, and from the *Xanthorrhœa Australis*, Mr. Barton from the red gum tree (*Eucalyptus resinifera*), and Mr. J. Drummond from the root and leaves of the "Boro Blackboy" (*Xanthorrhœa Drummondii*), which grows from 20 to 30 feet high, and produces more resin than any of the other species. From its tenacity it is used by the natives in making their hatchets, hammers, &c., and in fixing the glass to their spears. A pocket of native hops, *Erythrea Australis*, is also worth notice, and we must not omit to mention an excellent prepared seaweed, the *Eucheuma speciosa*, rewarded with a medal, which is said to make an excellent jelly. There are other edible articles of colonial produce in emu eggs, reported to be excellent food; olive oil, preserved fruits, meat and fish, including kangaroo tail, mullet, whiting, salmon, schnapper, &c.

Woods.—The principal timber trees of this colony are of the Eucalyptus or myrtle family. Those chiefly valuable for ship-building purposes are known by the native names of the Jarrah and Tooart.

Of these woods it was stated, a few years ago, by Admiral Sir James Stirling, before a Committee of the House of Commons, that there is sufficient in the colony of Western Australia to build at least twenty British navies.

None of the other Australian colonies possesses timber of similar character to the Jarrah (*Eucalyptus rostrata*), or endowed with equally valuable properties.

The Jarrah is remarkable for its enduring qualities, for its resistance to decay—setting at defiance time, weather, water, the white ant, and the sea worm. One of the pieces of wood exhibited (No. 20) is a pile from a jetty in the sea at Freemantle, where it remained during a period of twenty-nine years. The lower portion was under water, exposed to the attacks of the sea worm, which in those seas destroys every other kind of wood in a very short time; the middle was between wind and water, submerged or exposed with every change of tide; the upper portion was always exposed to the action of the weather, to the intense sun of summer, and the long-continued rains of winter.

Another piece of the same species of wood (No. 39) has been buried underground for thirty-one years untouched by the white ant, which in a few months destroys every other kind of wood so circumstanced. For this valuable quality, the Jarrah is now much sought after for railway sleepers in the other Australian colonies and in India.

The Jarrah, when better known, will doubtless be found available in the ports and dockyards of the United Kingdom for piles, dock gates, and other purposes, for which kyanised woods have been found inefficient. It is also admirably adapted for keel-pieces, kelsons, and other heavy parts of ship-building.

The Tooart, and an analogous wood, the blue gum, which grows in the southern parts of the colony in vast forests and to an enormous size, are equally valuable for many purposes of ship-building. The grain of each is remarkably close; the wood is as hard as box, and it has been found capable of enduring, without splitting or rending, a great amount of heat; it is not only well adapted for capstans, windlasses, &c., but also for engine-rooms and other parts of steam-ships exposed to the action of fire.

Both the Tooart and Jarrah were used to a small extent in the construction of H.M.S. "Hannibal," and the former wood especially met with high encomiums from the Surveyors of the Admiralty. The colonists, however, to whom both woods are familiar, are inclined to give the highest praise to the Jarrah, which is useful for so many purposes.

Vessels of considerable burthen have been built almost entirely of this wood, the peculiar properties of which render copper sheathing unnecessary.

The-sandal wood of Western Australia has long formed a valuable article of export to Singapore and China.

A tree of the Eucalyptus species, and of the size of an apple-tree, is called by the colonists raspberry-jam (specimen No. 30), from the similarity of its scent to that preserve. It is a handsome wood, well fitted for cabinet purposes.

The casuarina, or shea oak, is used for axe-handles, the spokes and felloes of wheels, and other purposes of husbandry.

The white gum is employed for similar purposes. This and other woods of a like texture are used for tram lines whenever they are required for temporary purposes.

The only other hard wood of the colony here represented is the morrel, a species of Eucalyptus with a rough bark, which, on account of its elasticity, is found useful for light shafts.

Wines.—The cultivation of the vine has for some years engaged the attention of a small portion of the colonists of Western Australia.

The rapid growth of the plant in all parts of the colony, irrespective of soil and the luxurious and bountiful produce of fruit, has proved that so far as quantity and quality of grapes are concerned, the colony stands second to no part of the world.

In regard to the quality of wine that has hitherto been produced, it is somewhat difficult to speak in high terms of praise. It must be remembered that till within the past five years the manufacture of wine has been carried on more in the shape of an experiment than as a matter of export.

Those persons who have succeeded in producing a liquid of a palatable nature have realised a price bordering on that paid for imported wines, and have consequently increased their vineyards to a considerable extent, and are making from four to five thousand gallons annually, for which they are enabled to secure a ready and remunerative price. At the same time others who have not been so successful have mixed spirits to a considerable extent with their wines, with a view to its sale among the lower classes; but, in general, the wines so treated have not been improved by the admixture.

That Western Australia can and will produce wines of a very superior quality, there is little doubt: its climate and soil are in every way suited to the culture of the vine, for which care and attention are alone required. The art of manufacturing good wine suitable for an export trade, and such as will rather improve than deteriorate by a sea voyage, is one that time and experience can alone teach.

It is hoped that many months will not elapse before some German Vigneron are introduced. This has been tried in South Australia with great effect and success, and the quality of the wine there produced has been such as to create a large demand for the article.

The vine may be considered in full bearing the third year from its planting, and will produce from three to twelve hundred gallons of wine per acre, varying according to the soil and description of wine.

Wool.—The first sheep introduced into Western Australia came with the early settlers from England, and were kept on the banks of the Swan until the discovery of the York district. Among them were several Saxony rams, the wool of which was exceedingly fine, but was found to get short and not well adapted to the climate.

The commencement of sheep-keeping in Western Australia, on any scale, must be dated from the opening of the York district in 1832, when Messrs. Bland and Trimmer drove a flock to the district, where they were found to thrive remarkably well. These sheep were chiefly of the Merino breed· the wool was fine in quality, and appeared rather to improve· but from the want of pure-bred rams the flocks became intermixed with those imported from the neighbouring colonies, being a mixed breed not so fine as the Merino, but somewhat longer in staple, but not commanding so good a price as the original Merino breed. The size of the carcase of the Merino was also thought too small when fresh meat was at a high price, and it was therefore considered an object to combine weight of carcase with the production of wool. With this object some very fine Cotswold rams of great size were imported, but only two succeeded in reaching the York district: from these numbers were bred, but the wool became coarse and hairy, and they were found anything but desirable to breed from for wool. A number of Southdown ewes were imported, but were not found to do well—either the climate or the grasses did not suit them; they became plethoric, would not breed well, and subsequently died, and have become extinct. Subsequently an entirely new breed was imported by Mr. Landor, known as Lord Western's breed, being a number of crosses between the Merino and Leicester. These sheep appeared to be suited both to the climate and the circumstances of the colony, as they combined pureness of quality with length of staple and large carcase. The wool of this description has always commanded good prices, while the meat is free from the coarseness of the large kinds of sheep in general. Many improvements in the weight of the fleece and length of staple have from time to time been imported. Some splendid rams of this description were imported a few years ago by Mr. G. Shenton, and sold at upwards of £30 per head; and more recently some exceedingly fine rams of the Romney Marsh breed have occupied much attention.

It would appear that the climate of Western Australia is very favourable to the growth of wool; its tendency being rather to become of finer texture and more soft. This probably arises from the amount of animal soap generated during the summer months.

As far as experience goes it would seem that the long-staple wool, combined with fineness, is the description which is most likely to command a good price; but in an article which varies so much according to the demand at the time, it is impossible to place any certain value on any particular description of wool.

NEW SOUTH WALES.

Number of Exhibitors, 470.

SITUATION IN BUILDING.—*Under the stairs of the North Gallery, near the East Dome and Nave.*

The eastern part of Australia was discovered by Cook in his first voyage in 1770. The bold character of the coast, and the broken outline of inland mountain, seen from the deck of the *Endeavour*, recalled to his recollection the well-known features of South Wales, and suggested the somewhat infelicitous, but now familiar, name of *New South Wales*.

The mineral collection from this colony is of much interest. A case of gold specimens is exhibited by Lady Cooper; and the Royal Mint of Sydney sends forty-eight samples of gold characteristic of the gold fields of this colony. Also a series of the various deposits met with in search for gold. There are many specimens of auriferous quartz of varied qualities. The production of gold has been as follows:—

Gold.—In 1851, the colony exported gold to the value of 468,336*l.*, in 1852 to the value of 2,660,946*l.*, in 1853 to the value of 1,781,172*l.* In the five following years (1854 to 1858), owing to the superior richness of the Victorian discoveries, the gold mining languished in New South Wales, the average not exceeding 600,000*l.* per annum. In 1859 the yield increased to 1,698,078*l.*, and in 1860 to 1,876,049*l.* In the ten years the colony exported 3,281,000 ounces troy, representing a value of 11,683,857*l.* sterling.

In 1861 the exports were as follows:—

GOLD in BARS EXPORTED from NEW SOUTH WALES.

	Ounces.	£.
British Colonies - - - - -	14,683	58,076
Suez and Aden - - - - -	22,848	91,812
Totals - - - - -	37,531	149,888

GOLD in DUST.

	Ounces.	£.
United Kingdom - - - - -	37	134
Victoria - - - - - - -	120	350
Other British Colonies - -	17,291	64,085
Suez and Aden - - - - -	371	1,484
Totals - - - - -	17,819	66,053

GOLD in SPECIE, the VALUE alone given.

	£.
United Kingdom - - - - -	241,043
Victoria - - - - - - -	809,640
New Zealand - - - - - -	1,000
Other British Colonies - -	38,100
United States - - - - -	150
Suez and Aden - - - - -	397,200
Other Foreign Countries - -	1,700
Total - - - - -	1,488,833

Coals.—The limits of the great coal field of New South Wales are at present imperfectly known; it is found to extend into Queensland, and to reappear in Tasmania, but it has not been practically opened out in either of these colonies. The mines now in operation are situate at or in the neighbourhood of Newcastle, at the mouth of the Hunter, 60 miles north of Sydney, and at Bellambi 40 miles to the south of that city. The total produce of coal in the last ten years has been 1,780,000 tons, of which more than one half has been shipped to India, China, and the neighbouring colonies.

The present appliances of the collieries in work are equal to the production and shipment of 20,000 tons weekly, and the average price for good screened coal at Newcastle is 12*s.* to 14*s.* per ton.

Mr. W. Keene, the government inspector of coal-fields, contributes a good map and sections, with examples of the super and sub-carboniferous rocks; and the coal measures presenting eleven different seams for working, all of which are, more or less, worked at various levels—from 450 feet below to 1500 feet above the sea.

The first, second, and third seams are worked in the Illawarra district, at Mount Keira, Bellambi, and Bulli; the third, fourth, fifth, sixth, seventh, and eighth seams are worked at Newcastle and Wallsend, and at Minmi and Tomago, on the Hunter River; the ninth, tenth, and eleventh at East and West Maitland.

For particulars as to the peculiarities of the several beds of coal, those interested are referred to the catalogue—well prepared—of the New South Wales Court.

The Australian Agricultural Company frequently ship 500 tons a day, and can readily supply a larger demand. The Wallsend Colliery sends coals to the wharf at the rate of 500 tons or more daily. The Minnie Colliery Company raise about 300 tons a day. The Tornago Company supply from 100 to 150 tons daily. The coal brought down from the mountain side varies from 100 to 200 tons daily.

The total produce of coal in the last ten years has been 1,780,000 tons.

Iron.—Iron is exhibited from the Fitzroy Iron Mine, where it lies in a compact mass, and extends to a considerable depth. As visible on the surface, it covers an area of about 16 acres. At a distance of one mile and a half from the iron there have been found four seams of coal, in a sinking of 100 feet, one being 4 feet in thickness. There are in the immediate vicinity beds of excellent fire-clay, several feet in depth, from which the best class of fire-brick, and most enduring crucibles, have been made. The ore of this mine is not an *iron stone*, such as is ordinarily met with in mines of iron, but an *iron ore*, combined with the oxide of several other metals, as nickel, rhodium, manganese. One feature of these ores is particularly striking. They are readily reduced to the metallic state; the earthy matter with which they are combined forming a slag without the addition of a flux.

The magnetic iron ore, exhibited by the Australian Agricultural Company, is, from their estate, 4 miles south-west of Stroud, about 24 miles from the harbour of Port Stephens, and 10 miles from the head of the navigation on the Karuah

River. The vein which has been laid open is 5,000 feet in length, 20 feet in width, and 2 feet 3 inches in thickness, with an easy inclination to the side of the hill. The following are the results of a rough analysis of the ore, performed at the Sydney Branch of the Royal Mint in 1856:—

Metallic Iron	55·5	per cent.
Silica	16·4	„
Alumina and lime	7·8	„
Oxygen	21·0	„
	100·7	

Copper.—Copper ores are exhibited from the Ophir Copper Mine, in the county of Bathurst, from the Old Oakey Creek Copper Mine, now known as the Cadiangullong Mine, from the Carangara Copper Mine, the Carcoar Mine, and from the Molong and Canobolas Copper Mines.

The specimens of lead and silver ore sent for exhibition are very small; one is from Manar, near Goulburn, another from Burrowa, and a third from Jobbins' Mine near Yass. Mrs. Gordon describes her specimens as taken from a shaft sunk at Manar upon the banks of Reedy Creek, which is a continuation of the Maloon Creek joining the Long Swamp, and untimately running into the Shoalhaven River at Tarbert. The shaft has been sunk to a depth of 80 feet. Veins or lodes can be traced for a considerable distance on both sides of the creek.

Marbles, building-stones, and clays are also exhibited.

This colony makes a very complete display. Here manufactures and, to a considerable extent, the fine arts are represented, in addition to an admirable selection illustrative of the natural produce of the country. That many branches of manufacture are very creditably carried on is evident from the contents of this Court, and especially so in the excellent woollen fabrics which are exhibited. There were at the end of 1860 not less than 938 mills and factories at work, and these comprised the manufacture of steam-engines, hardware, cloth and tweeds, leather, soap, candles, refined sugar, and pottery. Of the value of this colony to the mother-country some idea may be formed from the fact that since the last Exhibition it has purchased goods from this country to the value of thirty-three millions, and has sent us its produce in return to the value of twenty-millions.

The most important feature in the court of New South Wales is undoubtedly that of the wool and woollen cloths made from it. There are seven specimens of fleece wool washed on sheep's back, nine of scoured wool, and ten in grease. Beef and tallow are shown, and there are two jars of tallow from the newly introduced alpaca; one of pomade from this animal is exhibited by the Commissioners for the New South Wales Exhibition. In its pastoral industry this colony takes the lead of all the others. In 1860 the colony exported over twelve millions of pounds of wool, of the value of nearly a million and a quarter. The extent of the pastoral industry of the five colonies will be seen from the following table:—

Colony.	Sheep.	Cattle.	Horses.
New South Wales	6,119,163	2,408,586	251,497
Victoria	5,794,127	683,534	62,288
Queensland	3,449,350	432,893	23,504
South Australia	2,824,811	278,265	49,399
Tasmania	1,700,930	83,366	21,034
General Totals	19,888,381	3,886,641	314,722

For this vast amount of wealth Australia is mainly indebted to Capt. Macarthur, who, about the close of the last century, introduced into New South Wales, from the Cape of Good Hope, three rams and five ewes of Spanish merino blood. A cross with the coarse wool sheep of the colony, was obtained, and the result exceeded his most sanguine expectations, and he earnestly impressed upon the Government at home the importance of encouraging the growth of fine wool by making grants of unoccupied lands to the flockmasters. It is worth while at the present time to record that, at the period when the merino sheep were first introduced, there were but 1,531 sheep, 227 cattle, and 57 horses in the colony. Captain Macarthur's report to Lord Hobart, the then Secretary, concluded with these words, which attest the foresight and enterprise of one whose name deserves to be held in honour among Australians:—

"Captain Macarthur is so convinced of the practicability of supplying the country with any quantity of fine wool it may require, that he is earnestly solicitous to prosecute this, as it appears to him, important object; and, on his return to New South Wales, to devote his whole attention to accelerate its complete attainment. All the risk attendant on the undertaking he will cheerfully bear—he will require no pecuniary aid—and all the encouragement he humbly solicits is the protection of Government, and permission to occupy a sufficient tract of unoccupied land to feed his flocks."

There are specimens of the wool and of the cloth made of the fleeces of the alpaca.

A very great attraction in the New South Wales Court is the group of stuffed alpacas from the flock of Mr. Ledger, introduced into the colony at great labour and expense. The stuffed specimens represent the pure Alpaca and the pure Llama, and the four stages of breeding—the last cross having all the characteristics of the pure alpaca: these are interesting to naturalists, who have hitherto denied the possibility of the production of the pure alpaca from the crossing of the alpaca and the llama; and also to manufacturers, as showing the animal which produces a wool that in a few years will doubtless constitute one of the principal sources of Australian wealth.

The following are the particulars of the animals:—No. 1 is a brown and white pure bred female llama, aged five years three months; No. 2, a gray pure male alpaca, aged two years nine months; No. 3, a black, cross between similar animals to Nos. 1 and 2, age two years nine and a half months; No. 4, a brown, from dam similar to No. 3 by sire ditto to No. 2, age one year eight months; No. 5, a brown, from dam similar to No. 4, by sire ditto to No. 2, age one year three months; No. 6, a black, from dam similar to No. 5, by sire ditto to No. 2, age seven months; and No. 7, a lamb, suckling, from dam similar to No. 6, by sire ditto to No. 2, age three months. It will be observed that the llama is the largest-framed animal, has short coarse wool, legs, belly, head, and face bare, long neck, with very short wool: ears large. The pure alpaca has a smaller body; finer, heavier, and longer staple of wool; head and face covered; short ears; and this animal was not by any means a first-class one of its kind, having been selected on account of colour; although pure bred, he was not such as would be recommended to be bred from. The specimen No. 6 shows a great difference in this stage of cross breeding, the face being more covered than in the sire. The lamb, which is a suckling, was infirm, and was killed by Mr. Ledger, more to complete the group than anything else; yet its fleece will attract attention from its extreme softness.

Wood.—The timber of the colony is represented by more than three hundred specimens. Most of these have one side polished to show the grain, the other being left in a rough state, as sawn or split. Most of the specimens were unfortunately shipped in an an unseasoned, green state, and they show cracks in various parts, and others are very much warped. Under such circumstances, justice is not done to the merits of the wood. The cedar attains noble proportions in the colony. It is extensively used in joiners' and cabinet work, is largely exported to the neighbouring colonies, and is favourably known in this country. There is a boat made of this wood shown, and beautiful doors and table tops. The fig-tree also grows to enormous dimensions; the largest one that has been actually measured had a girth of 86 feet. All the varieties of the giant *Eucalyptus*, or myrtle, are shown—there are 124 specimens: this wood is admirably adapted for knees and ship timber, for building purposes, wheelwright's work, and railway sleepers. One of these trees was found in full vigour, and with no external symptoms of decay, 41 feet in girth, with the bole of immense height. There is one specimen of the white myrtle description, the largest of which measured 127 feet in girth. The woods from the northern district are finer than than those of the south. The wooded district of the north occupies both sides of the Clarence River for upwards of sixty miles, and the number of species of trees and the size to which many of these attain, especially on the tableland are extraordinary. Some of the red cedars have been found of ten feet in diameter, and yielding 30,000 feet of saleable wood. Many varieties of the *Myrtaceæ* are shown; they attain to the lordly height of over 100 feet, and range from 4 to 5 feet in diameter. Instances are cited of this wood remaining perfectly sound after having been for thirty years worked up as ribs of vessels.

The *Araucaria Cunninghamii* is a noble tree which grows in the greatest profusion in all the brush forests on the Richmond; the timber from the inland or mountain brushes is preferred to that from the coast. It is exported to Sydney in large quantities, the sawyers receiving at the present time 2*l.* 10*s.* per thousand feet. Some trees will yield as much as ten thousand feet of saleable timber. Spars for ships may be obtained in any quantity, from 80 to 100 feet in length: in some instances the tree attains a height of at least 150 feet, and from 4 to 5 feet in diameter. Here, as in the southern districts, the red cedar thrives in a remarkable manner. The wood is used very largely for all kinds of purposes; it is easily worked, and in dry situations is very durable. A good specimen of this wood is equal in quality to the best mahogany, to which it is very similar in appearance. The tree grows to an enormous size on the table-land of the Richmond, from which, and the adjoining district of the Tweed, the principal supply is now obtained. One tree, lately cut down at Lismore, measured 10 feet in diameter at the base, and was calculated to yield 30,000 feet of saleable timber.

One description of wood, the *Pittosporum undulatum*, a common tree in the brushes of Illawarra, has been favourably reported upon by Mr. Delamotte, for its suitability for wood engraving. For best descriptions of cabinet-work, the specimens No. 73, *Stenocarpus salignus*, beefwood; No. 85, *Acacia* *sp.*, sallow; No. 85*b*, *Acacia sp.*, silver; 100 *Frenelea sp.*, cypress or pine; 101, *Casuarina suberosa*, beefwood or shingle oak—are well fitted. Various articles of furniture, made from these and other specimens of woods in the southern and northern collection, are exhibited in this court. There are twenty-one varieties of the *Eucalyptus* which are to be tested for strength; they are—White iron bark, broad-leaved iron bark, iron bark, narrow-leaved iron bark, box of Illawarra, bastard box, a variety of gum, blue gum, &c.

A number of specimens, showing the great durability of this wood, are shown. Among these there are two posts of the stringy bark, placed in the ground in 1815, forty-six years since, still sound and perfect; posts of the narrow-leaved iron bark—also placed in the ground in 1815, forty-six years ago; section of post in the ground since 1821, forty years old; and a butt of post in the ground since 1823, thirty-eight years old—each of these being certified and exhibited by Sir William Macarthur. A piece of timber from the hull of the steamer *William the Fourth*, certified and exhibited by Mr. Edye Manning, is shown; it is one of the variations of the spotted gum. With the exception of some slight charring on the mere surface of the timber in the immediate vicinity of the boilers, the entire fabric of this vessel is as substantial and sound as when she was built in the year 1830. There are also turpentine wood, cut down and constantly exposed to atmospheric action for upwards of twenty-nine years; blackbutt, cut down and exposed to damp for fifteen years; mahogany, cut down and used as part of a fence to a vineyard and paddock for about seventeen years; iron bark, cut down in 1836, and constantly exposed to atmospheric action till September, 1861, or twenty-five years; ash, used as part of a mill, and exposed to all weathers for about fifteen years; and blood-wood, which has been under ground twenty years.

In the three articles of wool, gold, and timber, which form the staple products of the colony, New South Wales makes an admirable display.

New South Wales has nine contributions of very excellent samples of all varieties of cotton, and has the honour of exhibiting one which has been valued by the jurors at 4*s.* per lb. There is also a very good fair Orleans, worth at the present time 14*d.* per lb., and this variety is likely to be fairly tried in the colony, and about 200 acres are to be planted this year.

There may be at present about five acres under cultivation for cotton; but if the results are satisfactory, extension will be rapid, as the colonists are quite aware of the important trade which is now open to universal competition.

No. 76	From Clarence River; very good fair Orleans; worth - - - - - - per lb.	13*d.* to 14*d.*
77	From Hunter River.	
78	Ditto Very red, Sea Island, long and strong	
79	Ditto, lat. 32° S.—Long beautiful Sea Island, worth - - - - - - - -	3*s.*
81A	Ditto ditto - -	3*s.*
81B	Kidney seed, very good cotton, worth - -	18*d.*
81C	Rather high-coloured Sea Island, worth - -	2*s.* 6*d.*
81D	Valued at 4*s.*; and it is worthy of note that this sample was grown about fifty miles inland, which, being so far from the sea, may be taken as a proof of the suitableness of the climate and soil of New South Wales for Sea Island Cotton.	
83	Very good (green seed); fully equal to fair Orleans - - - - - - - -	14*d.* or more
83A	Very good Sea Island, worth - - - -	3*s.* to 4*s.*

VICTORIA.

Number of Exhibitors, 542.

SITUATION IN BUILDING.—*In the North-eastern Transept near the Dais of the Eastern Dome, and in a court under the Gallery between South Australia and Nova Scotia.*

The district of Port Phillip (subsequently named Victoria, in honour of Her Majesty) was separated from New South Wales on the first day of July, 1851.

The progress which has been made since that time is somewhat remarkable, and this colony now advances with singular energy in every department of industry. The peculiar features of this advance may be studied in the photographic portraits of the natives, exhibited, and in the pictures of Melbourne as it was and is. The characteristic scenery is faithfully delineated, with much artistic skill, in the series of paintings in oil and water colours, which are hung in the Transept. Mr. G. Rowe's collection has been well described by the Jurors, as "faithful and beautiful delineations of the country, workings, and other relations of the gold fields."

Mr. Brough Smyth aids in conveying to all a correct idea of the colony, in his topographical delineation of various mining districts, with the lines of the gold-bearing veins and runs. Mr. Alfred Selwyn instructs us on the Geological formations of the colony, the survey being under his direction: he exhibits a map of the work already done.

Professor McCoy aids in this work by his collection of fossils, which illustrates the order of the sedimentary rocks; and he exhibits some admirably engraved plates of fossils. Mr. Daintree has some well-selected photographs which are directed to the same end; they are strikingly illustrative of Victorian geology.

There are other exhibitors of the same order. Mr. Davison has a detailed survey on a large scale of one of the richest gold fields of the colony.

Of the mineral character of Victoria there is not space to speak in this small work. Of Mining, Mr. R. Brough Smyth writes, in his admirable paper on "Mining and Statistics of Gold"—

"Mining in the colony of Victoria is confined almost exclusively to the working of, and the extraction of gold from, the auriferous rocks. The extraordinary richness of the gold fields, absorbing nearly all the available labour in the country, has to a certain extent prevented the exploration of the deposits of tin, antimony, iron ore, and coal, which are known to exist; but now that the gold fever has passed its climax, the attention of capitalists is directed to other mineral resources, and if in this paper, they occupy but a limited space, and appear unimportant, there is yet reason to believe that in a short time they will be largely developed, and afford employment to a great number of persons."

To the paper quoted the interested inquirer is referred.

To gold, especially in connection with this colony, some space must be devoted.

"Licences to dig were first issued on the 1st September, 1851, and such great yields were reported, that the colonists very soon left their ordinary occupations for the exciting work of searching for gold. In 1851, the total male population of the colony was only 46,202, and the sudden withdrawal from their usual pursuits of nearly the half of these, produced a change in the social condition of the country, which eye-witnesses describe as the most wonderful revolution which the world probably has ever witnessed. Lawyers forsook the courts, merchants the counting-houses, clerks their desks, and artisans and labourers fled precipitately from houses but half built, and foundations but partly dug. Even clergymen were drawn to the exciting scene, and not in every case did they confine themselves to their calling."

The following statistical returns will best give the history of this remarkable gold field:—

The export of gold through the Customs, in 1851, was 145,146 oz., of the value of 580,587*l.*; in 1860, 2,156,660 oz., of the value of 8,626,642*l.* The aggregate in ten years was 23,917,980 oz., of the value of 95,671,918*l.*; to which must be added a moderate proximate estimate of the quantity exported through other channels—2,067,064 oz., of the value of 8,269,258*l.*—giving a grand total of 25,985,044 oz., of the value of 103,941,976*l.*

As there is no work except the statistical papers published in the colony which gives any concise account of the remarkable production of gold in Victoria, it is thought advisable to devote a few pages to this matter.

EXPORTS of GOLD from VICTORIA, 1851—1860.

YEAR.	QUANTITY.			TOTAL VALUE, at £4 per oz.
	oz.	dwts.	grs.	£.
1851	145,146	14	16	580,587
1852	2,724,933	5	1	10,899,733
1853	3,150,020	14	16	12,600,083
1854	2,392,065	9	19	9,568,262
1855	2,793,065	8	16	11,172,261
1856	2,985,695	17	0	11,942,783
1857	2,761,528	8	0	11,046,113
1858	2,528,187	19	12	10,112,752
1859	2,280,675	13	0	9,122,702
1860	2,156,660	12	0	8,626,642
Total	23,917,980	2	8	95,671,918

The gold referred to in the above table was regularly passed through the Customs, but a considerable quantity has also at various times been taken from the colony by private hand; this latter has been computed to have amounted, up to the end of 1860, to upwards of two millions of ounces (2,067,064 oz.); which, added to the quantity passing through the Customs, would give a total of 25,985,044 ounces, of a value of at 80s. per ounce, of 103,940,176*l.*

The total quantity of gold received by escort from the various gold fields during the year 1861 was 1,832,887½ ozs., and the total quantity of gold exported during the same period was 1,967,420 ozs.

As a considerable proportion of the gold now obtained is procured from the quartz reefs, the following table showing the yield of the auriferous quartz of the different districts will, for many, possess especial interest.

AVERAGES:—YIELD from QUARTZ, 1860, as EXTRACTED from the MINING SURVEYOR'S REPORTS.

DISTRICT.	Division.	Tons.		Produce.		Average per Ton.		
		tons.	cwt.	oz.	dwt.	oz.	dwt.	gr.
Ballaarat.	Number One Division	1,909	0	..	..	..		..
	Number Two Division	..	..	677	15	0	7	2
	Number Three Division	4,379	0	1,626	19	0	6	12
	Number Four Division	433	0	502	2	0	1	3
	Number Five Division	2,230	0	1,078	0	0	9	15
	Number Six Division	10	0	9	0	0	18	0
	Creswick	50,614	0	32,796	2	0	12	23
	Gordon	1,185	0	754	10	0	13	7
	Steiglitz	98	0	863	18	8	16	7
		267	0	270	0	1	0	5
	Total	61,075	0	38,378	16	0	12	13
Beechworth.	Spring Creek, &c.	..	..	..	..	..		..
	Yackandandah, &c.	4	8	5	10	1	5	0
	Indigo	480	5	944	8	1	19	8
	Buckland	3,241	3	12,912	8	3	19	16
	Total.	3,725	16	13,862	6	3	14	9
Sandhurst.	Kangaroo Flat, &c.	42	0	406	0	9	13	8
	Eaglehawk	23	0	341	9	14	16	12
	Bendigo Flat	..	..	..	..	..		..
	Heathcote Waranga and Whroo	2,550	15	4,906	0	1	18	11
	Kilmore	63	0	708	8	11	4	21
	Total.	2,678	15	9,361	8	2	7	1
Maryborough	Maryborough	3,943	0	3,482	0	0	17	15
	Amherst	331	0	298	10	0	18	0
	Avoca and St. Arnaud	..	..	..	..	..		..
	Dunolly	50	0	20	0	0	8	0
	Inglewood or Korong	224	0	2,544	11	11	7	3
	Total.	4,548	0	6,345	1	1	7	21
Castlemaine	Castlemaine	6,367	0	6,215	2	0	19	12
	Hepburn	101	0	627	8	6	4	5
	Maldon	3,802	5	3,883	18	1	0	10
	St. Andrews	226	0	1,079	0	4	15	11
	Taradale	2,638	10	2,614	3	1	0	14
	Fryer's Creek	267	0	536	0	2	0	3
	Total.	13,301	15	14,955	11	1	2	11
Ararat	Ararat Pleasant Creek & Raglan	1,265	10	2,002	10	1	11	15
	Total.	86,594	16	81,905	2	0	18	22

GOLD in BARS EXPORTED from VICTORIA (AUSTRALIA) in the YEAR 1859.

	Ounces.	£.
United Kingdom - - -	1,994,356	7,978,750
New South Wales - - -	45,233	180,928
Hong Kong - - - -	86,167	342,690
Ceylon - - - - -	6,286	25,749
Other British Colonies - -	79,577	317,398
United States - - - -	72	314
Guano - - - - -	6,087	24,343
Suez - - - - - -	63,107	252,206
Other Foreign Countries -	65	259
Totals - - -	2,280,950	9,122,037

GOLD SPECIE EXPORTED during the same YEAR, the VALUE alone given.

	£.
United Kingdom - - - -	543,052
Australian Colonies - - -	41,498
British East Indies - - -	16,176
Aden - - - - - -	5,962
Ceylon - - - - - -	138,158
Hong Kong - - - - -	18,465
Mauritius - - - - -	356,878
Guano - - - - - -	30,500
Sourabaya - - - - -	16,000
Suez - - - - - - -	123,546
Other Foreign Countries - -	14,757
Total - -	1,304,992

In the return of gold, per escort, the quantity forwarded by the Government escorts to Sydney and Adelaide, and the private escorts of Melbourne, during the years 1852, 1853, and 1854 is included. It is not known whether the quantity forwarded by the two first-named escorts overland is included in the export column of this return. The amounts were in 1852, 230,256 ozs.; in 1853, 178,022 ozs.; and in 1854, 6,031 ozs.

Table showing the **Yield** of **Gold** as indicated by the **Quantity** brought down by **Escort**, and the **Amount Exported** since 1851.

Year.	Per Escort.	Exported.	Value at 80s. per oz.	Average Earnings per Year of Persons on the Gold fields.	Value of Yearly Earnings at 80s. per oz. for each Person.	Average Earnings per Year for each Miner.	Value of Yearly Earnings at 80s. per oz. for each Miner.
	oz.	oz.	£.	oz. dwt.	£.	oz. dwt.	£.
1851, three months in	104,154	145,146	580,484	7 10	30		
1852 . .	2,277,026	1,974,975	7,899,900	58 8	233	No distinction made in the returns of population for these periods between miners and others.	
1853 . .	2,065,903	2,497,723	9,990,892	47 6	789		
1854 . .	1,482,697	2,144,699	8,578,796	32 12	130		
1855 . .	2,132,397	2,751,535	11,006,140	25 1	100		
1856 . .	2,625,968	2,999,191	11,996,764	26 0	104		
1857 . .	2,481,020	2,755,956	11,023,824	20 16	83		
1858 . .	2,371,268	2,528,102	10,112,408	17 3	68		
1859 . .	2,202,012	2,280,571	9,122,284	16 7	15	18 2	72
1860 . .	2,008,843	2,156,316	8,625,264	14 18	59	19 17	79
1861, six months to 30th June.	915,743	962,595	3,850,380	6 4	24	8 14	34
	20,667,031	23,196,809	97,286,238				

The quantity of gold exported from Victoria between October 1st, 1851, and October 1st, 1861, amounted to 26,162,432 ounces troy, equal to 800 tons 17 cwt. 3 qrs. 7 lbs., the value of which is 104,649,728*l.* The pyramid which stands under the Eastern Dome was designed by Mr. Knight, F.I.B.A., to show the comparatively small space which such a quantity of gold would occupy. The measurement of the figure is only 1,492½ cubic feet, yet the value thereby represented is one eighth of the national debt of Great Britain.

Since the pyramid was designed, the gold fields of Victoria have yielded a further quantity of 35 tons 10 cwt. 2 qrs. 6 lbs., the value of which is 4,642,328*l.* sterling. This is computed to the 19th April, 1862. Since this latter date another return has been received to the 12th of May, which gives an additional quantity of 138,003 ounces, value 552,012*l.*

Models of the principal "nuggets," or lumps of gold, which have been found in Victoria, are shown in low relief, on the lower portion of the pyramid. The pyramid is 44 ft. 9½ in. high, and 10 ft. square at its base.

Silver.—Silver is found in considerable quantities in the quartz reefs at St. Arnaud's and other places.

Tin Ore.—Black sand, containing a large percentage of tin, is abundant in the Ovens district, Taradale, Strathbogie, &c. Dalgetty and Co. are exhibitors.

TIN.

The following STATEMENT of EXPORTS of TIN, has been obtained from the CUSTOMS DEPARTMENT.

YEAR.	TIN.	TIN ORE.
1853 – – –	9 tons and 312 pkgs.	707 tons 11 cwts.
1854 – – –	– –	357 ,, 17 ,,
1855 – – –	– –	109 ,, 3 ,,
1856 – – –	1 ton 4 cwts. – –	97 ,, 11 ,,
1857 – – –	10 cwts. – – –	60 ,, 15 ,,
1858 – – –	1 ton 6 cwts. – –	88 ,, 2 ,, and 160 ingots.
1859 – – –	5 cwts. – – –	– –
1860 – – –	4 tons 18 cwts. –	59 ,, 13 ,,
1861 (first half of)	2 cwts. – – –	556 ,, 1 ,,

Antimony.—Antimony containing gold is found in large quantities at Heathcote;—a block of antimony weighing half a ton stands at the foot of the pyramid.

Iron.—Iron ore is plentiful: thousands of tons of rich ore are lying upon the surface of the ground at Sandhurst. Specimens of the ore are exhibited in the department. A remarkable mass of meteoric iron containing nickel is exhibited by Professor J. Abel, of Ballaarat, on the Daïs of the Eastern Dome.

Kaolin.—Fine beds of Kaolin are to be met with in various parts of the colony—a sample block from Bulla is exhibited. The clay from this place is now being manufactured into different articles by a Melbourne company.

There are numerous exhibitors of auriferous wash-dirt; and considerable quantities of quartz have been sent to the Exhibition, which is stamped in the open court at certain times of the day.

AUSTRALIAN GOLD-WASHING MACHINERY.

In the North Open Court of the Eastern Annex, and the North-eastern Transept, will be found an interesting illustration of the machinery and implements required, consisting of—

A set of twelve stamp-heads, driven by a small horizontal turbine; the stamps have iron shafts. The stamped stuff is carried out through gratings, and the whole arrangements are such as to allow of working through a large amount of stuff daily. The slimes are carried over a slightly inclined table, arranged in steps, which are covered with rough woollen cloths to catch the gold. The tail slimes pass over into a catch-pit, where a portion of their contents can be collected for further treatment.

A barrel mounted like those used in the European amalgamation process.

Model of three stamp-heads, in which the cam works in a slot or opening made in the iron stamper beam.

An iron grinding and amalgamating machine, modified from the Mexican arrastra. This is a circular trough of cast iron, of a ⌣ shaped section, in which a number of grinding pieces of iron of a similar shape are dragged round by a system of rotatory arms.

An hydraulic filter for filtering fluid amalgam, made like the hydrostatic coffee-pots, in which the filter is placed on a cylinder which fits closely into, and is lowered to, the bottom of the receiving-vessel. The filter is formed of buckskin leather. When the fluid amalgam has been put into the filtering vessel, the latter is hoisted up by a small windlass, and the small vacuum produced by the separation of the two vessels causes the mercury to be driven through the leather by the excess of the outer pressure.

A centrifugal separator, with four rotatory conical tables, resembling the round buddle, which are used with coarse woollen-cloth coverings.

Puddling-machines for working up auriferous clays.

Cradles, and other simple gold-washing machines.

Diamonds.—The diamond is said to occur in the Ovens district, and the local newspapers report that thirteen stones have been found near Beechworth. Machinery is about to be erected for washing the gravels where the stones have been found. Mr. Crisp (512) is an exhibitor of a diamond and some precious stones.

Topaz, &c.—The topaz is found in the Ararat district, at Castlemaine, Beechworth, &c. Fine stones, very suitable for optical purposes, have been obtained near Pleasant Creek, a tributary of the River Wimmera. Sapphires, zircons, &c., are found at Castlemaine and other gold fields.

Coal.—The coal-bearing rocks in Victoria occupy an area equal to about 3000 square miles, or 1,920,000 acres. These rocks occur in Gipps Land, in the counties of Mornington, Grant, Bourke, and Polwarth, and in the Portland Bay district. Very few seams of coal have been discovered; and respecting those there is scarcely any information available as to whether or not they can be economically worked. The seams at Cape Patterson vary in thickness from a few inches to 3 feet 9 inches. The Victoria Coal Company have applied to the Government, and received permission to raise 500 tons of coal; and if their adventure be pursued, it will tend to develop that coal field, and show whether or not the working of such coal seams can be profitably pursued at present.

Lignite has been found near Ballaarat, and in other parts of the colony, but it is not worked.

A sample of coal, found at the surface about 10 miles from Geelong, is exhibited by Mr. Wm. Nixon.

The extent of the collection of products of this fine and productive colony may be estimated by the enumeration of space which it occupies, compared with its neighbours of the antipodes. Victoria covers, in four different allotments, 5,665 superficial feet. The others cover the following areas :—

	Feet.
New South Wales - - - -	2,500
South Australia - - - -	1,800
Queensland - - - - -	1,462
West Australia - - - -	625
Tasmania - - - - -	1,600
New Zealand - - - -	625

Pastoral Industry.—The propagation of live stock, for which the climate and rich natural pasturage of Victoria offers eminent advantages, was the first colonial interest which attained great magnitude. The extent of land occupied for grazing was approximately ascertained in 1856 to amount to 32,326,468 acres. In that year 1,174 licenses were issued. In 1860, in spite of the quantity of land sold during the previous four years, the number of squatters' occupation licenses had increased to 1,223. The aggregate shipments of wool, tallow, hides, and skins, have amounted in money value, from 1837 (the foundation of the settlement) to the end of 1860, to not less than 20,358,306*l*. In 1860 the exports were 24,274,000 lbs. of wool, valued at 2,025,066*l*.; 788,144 lbs. of tallow, valued at 18,269*l*., and hides and skins to the value of 144,236*l*.

Fruits and Vegetables.—There is a fine collection of coloured gypsum casts of fruits, vegetables, and edible roots, showing the size to which these attain in the colony. The demand for fruit and vegetables, and the eminent capabilities of the soil and climate for bringing such productions to perfection, have had the effect of causing about 7,300 acres to be laid out as orchards and market gardens, making an increase in three years of nearly 2,500 acres, or upwards of a third.

Manufactures.—The efforts of the people of Victoria have hitherto naturally been exerted rather to the production of the raw material than in manufacturing industry ; but the latter has not been altogether neglected, as the returns for 1860 exhibit no less than 474 mills and manufactories of various kinds in active operation. Of these, those connected with or dependent upon agriculture, numbered 129, and consisted of

94 mills for grinding and dressing grain, 86 of which were worked by steam, 7 by water, and 1 by wind, 1 oatmeal manufactory, 3 bread and biscuit manufactories, 20 agricultural implement manufactories, 7 steam chaff-cutting machines, and 4 bone-manure manufactories. Those working upon raw materials, the production of the pastoral interest, numbered 67, and consisted of 28 tanneries, 21 soap and candle manufactories, 15 fellmongers and curriers, 2 woolstaplers and washers, and 1 woollen flock factory. Works for the manufacture or preparing of food, the raw material not being the produce of agriculture, and for the manufacture of articles of drink, amounted to 77, as under:—1 sugar refinery and distillery, 2 steam coffee and spice mills, 2 ice manufactories, 38 breweries, 25 ginger-beer and soda-water manufactories, 7 cordial manufactories, and 2 cider manufactories. The number of works for the making of building materials and for carrying on plastic manufactures was 127, as follows:—64 saw-mills, 8 limekilns, 50 brick-yards, 4 drain-pipe and tile manufactories, and 1 pottery. The machine manufactories and those for working in brass and iron numbered 33, consisting of 20 iron, brass, and copper foundries, 2 iron rolling factories, 6 millwrights' and machinists', 1 saw-making, 1 wire-working, 1 chain, 1 lead pipe, and 1 boiler manufactory. The following miscellaneous works and manufactories were also returned: 21 coach factories, 1 railway carriage factory, 3 organ and pianoforte builders, 6 ship and boat builders' yards, 5 gasometers, 2 electro-platers, 2 curled hair factories, and 1 scale-maker.

Professor Mueller, F.R.S., the colonial botanist, thus speaks of the vegetation of the colony:—"A stately fan-palm (*Livistonia Australis*) raises its lofty, slender stems to a height of 80 feet, attaining there, for the noble order which it represents, the most southward extended geographical latitude. Its terminal bud affords the palm-cabbage, whilst the leaves are much sought as material for the manufacture of hats.

"Vast spaces of the scrub country are ornamented with varied plants of the utmost gayness, or covered with peculiar species of Eucalypti. The Mallee-trees, which, under the permanent occupation of the land are likely to disappear, but which are yielding now to the nomadic hunter, by their long horizontal retentive roots, the means of obtaining water in an otherwise waterless desert, and which invested at the summer season with the saccharine cup-like coverings of a half-developed psyllidious insect, furnish, together with the roots of various plants, the gum of various *Acaciæ* and *Pittosporum acacioides*, the sugary exudations of *Myosporum platycarpum* the fruits of *Nitraria* and *Santalum acuminatum* (the Quandang), additional means of subsistence to the aboriginal inhabitants of the soil. The pyramidical sandarac pine (*Callitris verrucosa*) and the weeping Exocarpus agreeably interrupt the monotony of the scrub-landscape. The fragrant Myall-wood, yielded in these parts of our colony by *Acacia homalophylla*, is one of our most valued ornamental timbers. The red gum-tree (*Eucalyptus rostrata*) indicates, as almost everywhere throughout the country, in long scattered lines, the course of creeks here subject to exsiccation. Beyond the ordinary means of pastoral cultivation much might be effected for the improvement of these parts of the country. The distribution of the date, which in some of the arid parts of Egypt, Arabia, and Persia, forms a considerable share of subsistence for the inhabitants, could permanently be effected. The sugar millet, a plant well calculated to resist the drought, and furnishing its luxuriant foliage during the hottest season, could readily and extensively be reared. The carob-tree, on which, although originally introduced from South Europe, many of the South American pasture-tenants are to a certain extent depending as a fodder fruit, could, no doubt, with many perennial economic grasses and herbs, be naturalized. All the culture plants of Middle and South Europe may be produced in copiousness and with facility; and how far agriculture and horticulture have, in a country comparatively so young, opened the paths to permanent prosperity, may be estimated by reference to the able statistic tables furnished on this occasion by the Registrar-General of the colony. Although the cultivation of the vine, compared to the growth of cereals, has remained hitherto in arrear, it has, nevertheless, been established by indisputable facts, that Victoria is not surpassed by many countries in the production of superior grapes for wine, which certainly at a future epoch, will take its place not only for principal home consumption, but also for commercial export. The growth of the vine in our latitude is one of remarkable celerity, and the yield of many sorts under experienced management most prolific. Perhaps an important branch of industry is open for future skill and exertions in the production of silk; copious plantations recently formed of the quickly growing Chinese mulberry-tree, testify that many of our colonists are persuaded of the great importance of encouraging this branch of rural economy.

"The timber resources of our colony are almost unbounded, although our forests are devoid of the larger coniferous trees. Eucalypti, often of colossal size and of great durability, including vast quantities of the blue gum-tree (*Eucalyptus globulus*), will yield in future their timber also for foreign markets, whenever the ramifications of the railway system shall have brought the interior more widely into contact with the harbours and coasts.

"One species of Eucalyptus, the stringybark-tree (*Eucalyptus obliqua* or *Eucalyptus fabrorum*) affords in its fissile wood vast materials for shingles: this tree, indeed, constituting in very extensive mountain districts the principal part of the forests. Hence, it is not improbable that its bark, which is readily separable, thick and fibrous, although not tenacious, will not merely continue to supply the roof for the first rustic dwelling of the settlers, but may eventually be drawn into use for the manufacture of a coarse paper, although neither this nor other native products are likely to yield a paper-material comparable to the available maize straw.

"The principal tree and shrub vegetation being myrtaceous, it may be anticipated to what an unlimited extent the volatile oil of these plants could be obtained for technological purposes.

"Eucalyptus leaves were for several years employed for making gas to light one of our country towns. The Eucalyptus furnishes also the Australian Kino resin in unbounded quantity. The tanners' bark, principally employed in this colony, is yielded by various Acacia (*A. mollissima*, *A. dealbata*, *A. pycantha*), and can be gathered in large quantities."

Under the name of quandung nuts, the seeds of *Santalum acuminatum* are strung for bracelets; and specimens set in gold are shown in the New South Wales and Queensland collections. The sandal-wood is a small tree, peculiar to the desert tracts, bearing an edible fruit, colonially called native peach. The fruit is of an agreeable acidulous taste, and usually every alternate year richly produced. Jam made of it is shown. The kernel of the fruit is edible and oily. Two other curious native products are the subterraneous fungus, usually called "native bread" (*Mylitta Australis Berk.*), occasionally ploughed up, which, by boiling, is rendered available for food.

Nardoo Fruit and Flour.—Sporangia of *Marsilea quadrifolia*, LIN., var., *hirsuta*, abundant in many depressed places subject to inundation, especially on the Murray River and its tributaries. Cakes are prepared from the pounded sporangia by the natives; and it was upon this food that several of the last exploration party into the interior sustained life for some time.

Woods.—The collection of colonial woods embraces more than one hundred specimens, duly named and described; wood specimens in book form, walking-sticks, gun-stocks, chess-boards, work-tables, frames, paper-knives, Myall wood pipes, and other illustrations of the woods.

The exhibition affords numerous illustrations of the indigenous materials for various industrial appliances, for the purposes of furniture, and for smaller articles of turnery, and ornamental workmanship. The admirable adaptations of blackwood (*Acacia melanoxylon*) to light and heavy framing of every description, to the naves and rims of wheels, and to innumerable specimens of cabinet-work of the highest excellence, are seen to great advantage, and obtained universal commendation. Numerous elegant pieces of ornamental work also displayed the peculiar beauty and figure, the closeness of grain, and, in some cases, revealed the fragrant odours of the smaller woods, and showed how well they are deserving of more extensive notice than they have hitherto received. Many of these lesser timber trees are comparatively unknown, and difficulties in the want of proper roads and available means of transport, have prevented the various treasures of the forests becoming readily accessible to the requirements of the artizans.

Fibres.—In fibrous materials there is little calling for passing notice. There is an Australian perennial flax shown, which, it appears, is not unfrequent in the colony.

Essential Oils.—The distilled oils shown seem to open up a field of investigation for the perfumer. There are oils shown from sassafras (*Atherosperma moschata*, *Eriostemon squameus*, *Correa speciosa*), from eleven species of Eucalypti, six specimens of Melaleuca, four species of Mentha, and oil of *Pittosporum undulatum*. The leaves for the Eucalyptus oils are in the vastest quantity obtainable throughout the whole country, although, for the respective kinds, often only in certain districts. The Australian mint can be gathered in unlimited quantities along most of the rivers of Victoria. *Mentha gracilis*, *grandiflora*, and *saturnioides*, occur in many parts of the colony. The flowers from which the *Pittosporum* oil was obtained, can hardly be collected remuneratively on the ranges; but the tree may be cultivated with great facility, and furnishes a profusion of flowers of an almost jessamine-like scent, desirable for distillation. On the proportionate yield of oil from these, its qualities, and the important uses to which they may be applied, the very interesting report of the local jury appended to the Victoria Catalogue, may be consulted.

Resins.—All the Eucalyptus resins, of which there are many shown, are largely and cheaply available: they are, for their astringent properties, employed in medicine, with kino and catechu. The resin of *E. viminalis*, or the manna tree, in its decomposed state, furnishes a real pigment.

Natural History.—There is a very fine natural history collection, contributed chiefly by the University of Melbourne. In connection with this subject we quote the following remarks, by Professor M'Coy, Director of the Museum there, and Professor of Natural History :—

"In the class of fishes many species remain yet to be determined. The more important species used as food are the 'schnapper' of colonists (*Pagrus unicolor*), abundant, and often of great size, with large numbers of which the market is regularly supplied, and which is caught and dried in great quantities by the Chinese fishermen in Hobson's Bay, and supplied to their countrymen on the various gold-fields. The next most important species, from its being almost equally abundant at times in the market, and of equally large size and superior flavour, is the great cod-perch, the 'Murray cod' of colonists (the *Grystes Peeli* of Mitchell, or *Oligorus Macquariensis* of modern writers). A very much larger (occasionally 5 feet in length), and finer fish for the table, only an occasional visitor, however, is the 'king fish' of colonists, which seems completely identical with the great 'maigre' of the Mediterranean (*Sciæna aquila*). Dr. Gunther, the most recent European writer on Ichthyology, in his general catalogue of Acanthoptarygian Fishes states that the family *Sciænidæ*, to which this fish belongs, has never been found in Australia. The fishes commonly called 'mullet,' *Dajanus Diemensis*, and 'whiting' by the colonists, *Sillago punctata*, are common, in the fish shops, for the table, together with three species of 'flat-head' (*Platycephalus nematophthalmus*, *P. tasmanius*, and *P. lævigatus*), which are caught abundantly in the Bay at all times. Another tolerably good table fish is known to the colonists, and is found in the market under the name of 'Pike,' though, like all the other fishes bearing the names of English species, it has little resemblance and no affinity to the fish of that name in Europe—it is the *Sphyræna obtusata* and *S. Novæ Hollandiæ*. The so-called 'herring' of the fishermen, is the *Centropristis Georgianus*, with which the market is also abundantly supplied. The 'baracoota,' which visits us regularly, and is in some request for the table, is certainly the Cape of Good Hope *Thyrsites atun*. The small ling, the *Lota brevinscula*, is occasionally procured for food on the coast, but is chiefly remarkable for the old full-grown fish (about a foot long), having, two or three years ago, been stated by some fishermen to be the young of the great Newfoundland cod; it was in vain that I pointed out the generic difference in the number of the fins, &c.; and that these supposed young were adult,' the 'practical men' carried conviction so far with them, that the merchants of the town subscribed some hundreds of pounds, twice, to fit out a vessel to commence a great cod-fishing, on a supposed cod-bank a few miles out, as a mercantile speculation. The dory (*Zeus faber*) is a rare visitant, and whether as delicious here as in Europe, I cannot say. A gar-fish (*Hemiramphus*), a tunny (*Thynnus*), and an eel (*Myrœna*), are also commonly used for food. Amongst useful fishes not good for food may be mentioned the common European sun-fish (*Orthagoriscus mola*), as not uncommonly caught in the Bay, for its large supply of oil.

"Of crustacea few kinds are used for food in Victoria: there are no true lobsters and no crabs fit for the table; but a spiny cray-fish, of about the same size and shape as the English species, is very common at the Heads, and is supplied abundantly to the market; it is nearly or quite identical with the *H. annulicornis:* the gigantic Murray River cray-fish (the *Astacoides serratus*) is now sent down alive in great numbers to the market for the table; the smaller river cray-fish (the *Astacoides quinquecarinatus*) is also often eaten in the country, but is not sent to market; it forms the chief food of the so-called 'Murray cod,' from the stomach of one of which I took twenty nearly perfect."

TASMANIA.

Number of Exhibitors, 148, who exhibit articles to the number of 668.

SITUATION IN BUILDING.—*Centre of North-east Transept.*

The colony of Tasmania occupies a prominent position in the centre of the North-east Transept, on the northern side of the Dome, and is both strikingly and appropriately represented by a lofty and not inelegant trophy, formed of indigenous timbers of the island; the design and material for the construction of which were transmitted to England from that distant dependency.

Tasmania, formerly known as Van Diemen's Land, is a somewhat escutcheon-shaped island, nearly as large as Ireland, lying about 120 miles south of the south-eastern corner of the Australian Continent. Its area comprises about 16 millions of acres, or about 25,000 square miles. It is of 165 miles average length, and 155 miles average breadth, and has 700 miles of coast line, exclusive of small islands and indentations. The central part of the island consists of a table land, averaging at least 3,000 feet above the level of the sea, on which are seven lakes, varying in size from 2,500 acres to 50,000 acres, and containing an aggregate of nearly 112,000 acres of fresh water.

Coal.—Mr. C. Gould, an enterprising young geologist, who was educated on the Geological Survey of the United Kingdom, after having been a student in the Government School of Mines, has contributed to this Exhibition an interesting series of coals.

Coal exists in nearly every part of Tasmania. The main portion of the fuel used in Hobart Town is derived from mines at New Town, in the close vicinity of the capital, and from Tasman's Peninsula; but it is generally believed that coal beds of far greater value than those, which have been worked principally on account of their easy accessibility, exist in other parts of the island. The series of specimens from Mount Nicholas will illustrate the coal bed to which public attention has recently been most particularly directed.

The same seam crops out near Fingal and at various other parts, but the main seam is that now illustrated by samples from different portions of it. This coal bed is estimated to occupy an area of about 14 miles, on the northern side of the Break o' Day plains. Various other portions of the bed are equally accessible, but although they are mostly bituminous they are inferior in thickness to the Killymoon seam. Bituminous coal samples are also furnished from the coal bed of the Douglas river and from Long Point, both on the east coast. The coal from both these districts is good, and the coal bed from which they are taken is said to extend over an area of about 15 miles, and the seam at the Douglas river to be above eight feet thick. At Long Point it is 6 ft. 10 in. thick, very bituminous, and within an easy distance of the shipping place. Beds in the Mersey River have also been found. The coal is very bituminous, is used by the coasting steamers and in Launceston, and has been recently exported to Victoria.

The bituminous coal from Hamilton is said to be very good. It lies about 40 feet deep, in a seam 4 ft. 6 in. thick, and has been used, and favourably reported on, by the Derwent steamers.

The anthracite coal is abundant on the southern side of the island, and specimens are exhibited from New Town, Tasman's Peninsula, Adventure Bay (Bruni Island), Three Hut Point in D'Entrecasteaux Channel. Four collieries are represented in the specimens from New Town, near Hobart Town. The seam is from 3 ft. 6 in. to 4 ft. 6 in. thick, is worked by a shaft 25 yards deep, and within about 100 yards of the water's edge.

The coal formation on the south side of the island extends round the mouth of the Huon to S. W. Cape, within which range many deposits have been discovered.

Gold.—The small portion of Tasmanian gold exhibited has been collected by Mr. James Grant, of Fingal, within a few months, from the few diggers who are surfacing and prospect ing about Fingal. More gold from that district is in the Hobart Town Banks, and might have been purchased for exhibition; but although, according to geographical and geological analogies, Tasmania *ought* to possess the precious metal in abundance, it has not yet been discovered in paying quantities, and the portion exhibited will give a fair notion of all the gold hitherto found. To stimulate exploration the Colonial Government has just offered a reward of 20,000*l*. for the discovery of a payable gold field. Gold has been found, principally of the character of that exhibited, in many parts of the island which are widely distant from each other.

Although in a new colony there may be some advantages in the excitement arising from the discovery of a paying gold field, the propriety of unsettling the steadier industry of the people, by the offer of such a reward, is very problematical. Auriferous quartz is also exhibited.

Gems, &c.—As showing the geological and mineralogical character of the locality, Mr. J. Milligan sends to the Exhibition topazes, jacinths, beryl, cairngorm, opal, carnelian, rock crystal, garnet, schorl, hornstone, and other rocks.

Lead, Copper, and Iron.—Galena and copper ore have been found in different parts of Tasmania, but not hitherto in any considerable quantity. Iron ore abounds all over the Colony. At Ilfracombe, eight miles from the Tamar, there are immense masses of rich ore, similar to that now exhibited, which will, doubtless, some day prove highly advantageous to the colony, in connection with the vast coal-fields of the east coast.

At the distance of eight miles from Port Dalrymple (the Tamar), in Van Diemen's Land, considerable quantities of iron ore have been discovered on the surface, which upon analysis in this country, have been found to consist of pure protoxide of iron (similar to the black iron ore of Sweden) and furnishing a very pure and malleable metal.

Mr. C. Gould is also a contributor of a very interesting geological collection, and some maps, illustrating his arduous labours, in the execution of which it was long feared he had perished. Fortunately, those fears have been dissipated by his return from the Bush. Long may he live in health to pursue his useful labours.

The ladies of Tasmania have been contributors to the interesting collection gathered in the Transept of the Exhibition Building.

A reference to the drawings of Mrs. Charles Meredith and Mrs. Allport, the embroidery of Mrs. Burgess, the *bouquets* of sea-weed and shell-work of Miss Collins and of Mrs. Cook, the wax fruit models of Mrs. Luckman, and the ornamental feather-work of Mrs. Crowther, sen.,—all on purely Tasmanian subjects—will amply prove that, whilst cultivating business habits of practical utility, the fair Tasmanians by no means undervalue those pleasing and elegant accomplishments which diffuse an atmosphere of cheerfulness around the enjoyments of home, and elevate and purify the graceful amenities of social life.

Woods.—The Tasmanian Court, partitioned off on one side from Nova Scotia, and on the other from Victoria, and walled in at either end with planks and panels of highly-polished furniture and cabinet woods of the island, has proved one of the most attractive and numerously-frequented in the building. Though darkened to some extent by enclosure on all its four sides, and by its ambitious trophy and Gallery overhead, it has gained wall space from the former, and has acquired additional horizontal area, and an imposing appearance and character from the latter. Within the enclosure the tower of the trophy, resting upon a foundation of solid masonry, passes through a platform of squared logs, heavy planks and ship-timbers, floored over with stringy-bark boards, and is then seen to rise through the Gallery with a spiral staircase in its centre, and to culminate in a flag-staff and loyal British ensign, near the highest part of the roof.

The pedestal, a paralellogram of 30 × 20 feet, by 12 to 15 feet in height, has a framework of timbers of great value for house-building, ship-building, engineering works, and for general carpentry: the gallery is floored with boards of blue gum timber, and the circular staircase, which is formed of the beautifully white wood of the plain Huon pine, so famed for its durability, is lined with ships' planks of great width, consisting of stringy-bark, and of the white and blue gum. On every hand, within the pedestal and around its walls are displayed specimens of ships' knees and crooks of a gigantic size, and which previous to the application of iron must have proved invaluable, keel pieces, heavy planking, railway sleepers, naves, felloes and spokes for carriage and waggon wheels, handspikes, axe and pick handles, staves for casks, shingles for roofing, park paling from 15 feet in length and 20 inches in width downwards, besides ordinary scantlings of market-timber, and a considerable number of the furniture and cabinet woods of the island, polished on one side to show their hard, close grain, and rich and varied markings and venation, of which the following are more especially deserving of notice:—ironwood, *Notelœa ligustrina*; muskwood, *Eurybia argophylla*; blackwood, *Acacia melanoxylon*; myrtle wood, *Fagus Cunninghamii*; Huon pine, *Dacrydium Franklinii*; a pre-eminently fine-figured plank of the last-named has recommended itself to the fine taste and sound judgment of Sir George Beaumont, by whom it has been secured for artistic purposes. There are also exhibited in this apartment some creditable examples of basket-work, with a bundle of peeled willows, together with carpenter's bench-screws made of sassafras wood, &c.; and here it may be remarked that the comparatively soft but close, clear and even grain of the sassafras timber is said to adapt it singularly well for sounding-boards of pianos, &c. In the colony it is chiefly employed as flooring-boards, and for the manufacture of shoe-lasts, &c.

The access to this apartment within the pedestal of the Tasmanian trophy is by a wide doorway and short flight of steps, on either side of which stand at each end respectively, a pair of huge oil casks (tun butts) of blackwood, and water casks of silver wattle, supporting two lower jaws of the sperm whale with the points upwards and their double row of trenchant teeth towards the spectator. Adjoining these are samples of sperm oil, black whale oil, porpoise oil, with casks for bread, beef, &c., and suspended from davits by the side of the gallery above, are two exquisitely-finished whaling-boats, built of Huon pine, with their gear complete. These boats were designed and executed respectively by Mr. Chandler and Mr. Miller, of Hobart Town, and in workmanship are models of the craftsman's art.

The whaling trade, as a branch of Tasmanian industry, yielding to the colony about £60,000 a-year, and training up a race of hardy sailors for her future marine, has been well and faithfully illustrated.

We understand that one of the whale-boats has been secured by Lord Willoughby D'Eresby to be used as an adjunct to yachting operations.

There are some elegant and useful articles of furniture exhibited in the eastern end of the court; amongst them a handsome wardrobe of Huon pine, a Davenport of muskwood, a bureau of myrtle-wood, an oval table of blackwood, London-made, and a round table of muskwood made in the colony, which has gained from the jurors an honourable mention.

Along with the woods are shown a few gums and gum-resins, a long series of vegetable fibres well adapted for the manufacture of paper, and a few specimens of barks used in medicine.

The wools exhibited in this Court, though not so varied and numerous as might have been expected, represent respectively flocks of 5,000 to 25,000 sheep and upwards, and for fineness of fibre and character of staple, stand very high in the estimation of brokers and wool-staplers. The colour and style of getting up of these wools have been generally admired, and is most creditable to the colony. Medals have been awarded to nearly all the exhibitors.

There are amongst the cereals which are shown at the same end of the Court, some capital samples of wheat, barley, and oats. The wheat weighs from 65 lb. to 66 lb. per bushel, the barley about 54 lb., and the oats give the astonishing weight of 51 lbs. 10 oz., as officially determined in the Exhibition Building. But the weight alone does not sufficiently indicate the valuable qualities of these grains, for the production of which soil and climate are equally favourable. There are also exhibited in this Court, filberts, almonds, walnuts, and sundry preserved fruits, besides a splendid series of models, in wax, of apples and pears, an illustration of the character of soil and climate of Tasmania, and of the English habits and pursuits which engage the time and attention of emigrants, and in which they appear to be so successful in their home in the far South.

Along the walls on each side of the Court, around the balustrade of the Gallery, are hung rich wrappers for carriage and railway use, and for couches, &c., made of indigenous furs of the Island. And at the western side of the Court are several cases attractively filled with muffs, boas, collarets, &c., all of which appear to have found a ready market; opening out to the hunter in Tasmania a new, if not an enhanced, prospect of gain.

Mr. Milligan exhibits a few very choice and valuable Tasmanian shells.

There is a large collection of bird skins, shown by Mrs. Crowther, together with ornamental feather mats, screens, &c.

There are also in the West end of the Court, and in the Gallery, several handsome glazed cases of Huon pine, containing the more rare animals, and a number of the birds of the island, fairly stuffed and mounted—the animals in rather a bold style.

There are two cases of remarkably soft and pliable leather made of Kangaroo and Wallaby skins, with boots and shoes of the same; some excellent kip leather, sheepskins variously prepared, &c.

Hung round the walls are stereoscopic views of scenery in the island, taken by Mr. M. Allport; and portraits of the aboriginal inhabitants, taken by the Bishop of the diocese, who is now in England.

There are a few pieces of exquisitely-embroidered work of an original character, by Mrs. Burgess, and there is a water-colour drawing on ivory, by Mrs. Allport.

But the visitor to this end of the Court ought not to leave it without giving special attention to the long series of delicately-finished drawings in water-colours, executed in her usual felicitous and artistic style, by Mrs. Charles Meredith, whose name is so well known in connection with Tasmania. The subject of her pencil and brushes on the present occasion is botanical; and very faithfully and beautifully she has rendered for our examination and quiet enjoyment here, the fair flowers which Nature has scattered so freely over the picturesque landscape of Tasmania, on the opposite side of the globe.

It is said that these drawings are intended to embellish a second volume of "Bush Friends in Tasmania;" we trust it may soon make its appearance, since it cannot fail to be worthy the fame of its fair authoress, and to afford gratification to those who may peruse it.

Near Mrs. Meredith's paintings, there are some interesting coloured sketches of scenery on the north coast of Tasmania, by Mr. J. Stuttered.

In the Gallery will be found, beside the objects enumerated, a few small but elegant articles of furniture, some unique turnery, specimens of bookbinding, and some really excellent sea-biscuits, &c.

Taken as a whole, the exhibition of products from Tasmania does credit to the gentlemen to whom their collection and care have been intrusted. Abounding in magnificent timber, in coal and iron, in wool, oil, and grain, she possesses all the elements of expansion and of national wealth. Her insular position and fine harbours, also, must give to her inhabitants a bias to maritime adventure: it requires, therefore, but little foresight to say that there is reserved for her in the far future, a numerous population, manufactures, commerce, and naval power. She will prosper if she always acquits herself as well as she has done on the present occasion.

QUEENSLAND.

Number of Exhibitors 92.

SITUATION IN BUILDING.—*Adjoining New South Wales, near North-east Transept; but to the West of Victoria and New South Wales.*

The mineral products of Queensland are quite insignificant, being indeed represented by one ton of copper ore.

Cotton.—Samples of Queensland cotton, from various localities, hundreds of miles apart, are shown in the present exhibition, conveying the gratifying fact that Sea Island cotton, of fine texture and quality, can not only be grown in the neighbourhoods of Brisbane, Maryborough, Gladstone, and Rockhampton, but also upon the elevated table lands of the colony: one sample picked from plants grown in a garden at Camboon, upon the Upper Dawson River, a distance of 200 miles from the sea-board, rivals in texture that grown upon the coast.

This interesting fact will give the manufacturers of England some idea of the vastness of the Queensland cotton field, and show them that there is a colony in Australia from whence a supply of this staple, equal to any demand, can be furnished, so soon as capital and labour are introduced into it for the purpose.

The specimens of Upland cotton, although few, are remarkably fine, and were grown on the coast country. They have a Sea-Island gloss, very unlike the coarse, hairy appearance of the same varieties met with from other parts of the world.

Mr. Thomas Bazley, writing to his Excellency Sir George Bowen, says:—

"To illustrate the practical benefit to be derived from the supply of cotton as well as sheep's wool from Australia, I have had a few dresses manufactured from the beautifully fine lace thread, No. 250, which I spun from Queensland cotton, and this has been blended with fine yarn made from the wool of the sheep of your colony, and, the experiment being most successful, the result is a fabric of close resemblance in softness and beauty to Cashmere."

There cannot be a doubt that the people of this enterprising colony can and will send us large supplies of Sea Island cotton.

Judging from the samples exhibited, in the form of a large bale of Sea Island cotton, and various cases of excellent samples contributed by numerous exhibitors, it would appear that there must be a large extent of land being put under cultivation, principally, if not entirely, of the Sea Island variety. The samples of Sea Island cotton from the Australian colonies are far superior to cotton of the same varieties from any other part of the world exhibited.

They most decidedly give a preference in Queensland to the Sea Island, for whilst there are fifteen exhibitors of that description, there are only two of the New Orleans variety, which, however, are particularly good samples, so much so that we would recommend the Queensland people to try both the New Orleans and also Egyptian, for it is quite possible that the return per acre of those sorts may be even more profitable than Sea Island.

The Commissioner, Mr. Marsh, states that the cost of cultivation is about 9*l.* per acre, and that the land is very well adapted to cotton culture.

The probable export this year will be about 200 bales, and the future production will entirely depend on the supply of labour. Coolie labour is not allowed, but Chinese labourers are admitted. The commissioner fears that cotton will not pay for the cost of land and labour.

Arrowroot.—Some tons of this article were manufactured last year in the neighbourhood of Brisbane and Maryborough. Some of the samples are generally considered to be equal to the best Bermuda arrowroot; and the reasonableness of its price per pound, and its superior quality, justify the conclusion that it may become an article of considerable export to the neighbouring colonies.

Independent of the produce obtained from the root, those tubers which, from size and imperfection, are not suitable for manufacture, as well as the stalks and leaves, possess very fattening qualities, and are adapted for feeding pigs and other domestic animals.

Maize.—The cultivation of maize in Queensland has been more general than any other crop, the returns from the rich brush land situated upon the river's bank being very prolific and remunerating. One great advantage attached to the cultivation of this crop is, that the planting extends over a large space of time, say from the middle of September until the middle of January, the early crop being pulled before Christmas, and the late sowing about the latter end of May. Maize grows equally well upon the table lands as upon the eastern coast, one sample having been grown about 1,600 feet above the level of the sea.

Sugar.—The remarkably fine sugar-canes exhibited, and rewarded with a medal, were grown at Cleveland, on the coast, and in the Botanic Gardens in Brisbane, and are said to be fully equal to any grown in the Mauritius.

The sample of rum exhibited is the first spirit made from the sugar-cane in Queensland. There can be but little doubt that sugar-growing will form one of the industrial occupations of the colony in the course of a few years.

Coffee.—The sample of coffee forwarded is the produce of one tree, growing but a few yards from the banks of the Brisbane river. The commissioners conceive this sample, although small, to be highly important, since it proves that the soil of Queensland is adapted to the growth of the coffee-tree, and furnishes an additional illustration of the capabilities of the colony.

Wool.—Wool forms the principal export of Queensland, to the extent of upwards of 5,000,000 lbs.

The number of sheep in the colony, on April 7th, 1861, amounted to 3,500,000.

Silk.—The samples of silk, although not large in quantity, are of the finest quality. Only recently have attempts been made to produce this article, and the success that has been already achieved is highly encouraging. The climate of the colony is admirably adapted to the growth of the mulberry and other plants suitable as food for the silkworm; and there is every inducement to prosecute this important and highly interesting branch of industry.

Dugong Oil.—This oil is procured from the blubber of the *Halicore Dugong*, which is found in great numbers in Moreton Bay, Wide Bay, and other northern harbours. It is exhibited as a new therapeutic agent, and as a substitute for cod-liver oil. The distinction between this and the cod-liver oil is that it contains no iodine, but it possesses all the advantages of the cod-liver oil without its unpleasant smell. The lean portion of the flesh of the animal is excellent eating, the aborigines being excessively fond of it, absolutely gorging themselves with the food when they are so fortunate as to capture one in their fishing expeditions. The skin, which is nearly half an inch thick, can be converted into a gelatine or glue. The bones of the dugong are hard and firm, and take a polish equal to ivory. Specimens of the animal have been caught in Moreton Bay weighing from five to six hundredweight; the fat or blubber yielding from five to seven gallons of oil.

There is a miscellaneous series which possess considerable interest, such as aboriginal decorations and weapons. Mrs. Marsh contributes a sachet made of Queensland woods, brooches of white topaz found at Moreton Bay, and bracelets of Myall. The Natural History of the colony is illustrated by cases of stuffed birds and beasts. The water-mole (*Ornithorinchus*) and the Australian hedgehog are interesting specimens. There are several photographs of good character, a map of the colony, and specimens of printing, all showing that the advantages of the mother-country are gradually aiding in the advancement of the colony.

NEW ZEALAND.

Number of Exhibitors:—Auckland, 78; Nelson, 20; Otago, 1; Wellington, 14.

SITUATION IN BUILDING—*Under North Gallery, fronting Nave, to the west of New South Wales.*

The mineral collection from New Zealand is by no means large. There is an interesting case of gold specimens from Otago, consisting of 500 hundred ounces of gold; some gold from Tarawiti; gold and auriferous quartz from the Waiaw, Coromandel Harbour, and auriferous sand from Kapanga.

Copper ores are sent by the Great Barrier Company. Coal is exhibited from Kupa Kupa, Waikato, and also from the west coast.

We have the following returns of New Zealand gold:—On the 22nd and 28th of November, and on the 15th of December last, the escort conveyed respectively, 21,000, 15,000, and 14,000 ozs. The total amount of gold brought down by escort up to the 20th of December last, is 191,831 ozs., value of about 738,550*l*.

There is but a small display of wools; kauri gum is shown, and New Zealand flax; photographic views are rather plentiful. Unlike the other Australian colonies, no special or descriptive catalogue of the collection is published. The beautiful woods are however well represented; there are some pretty cabinets and tables of inlaid woods: samples of wood cut in the shape of books, are externally highly polished to throw up the grain; and opening with hinges at the back, the interior shows not only the natural, or unpolished appearance of the wood, but in the sunken cavities, the bark, the leaves, and in some instances the fruit, flower, or seed of each specimen.

Besides fleeces and other samples of wool, there is cloth made of Nelson wool, much used, especially for volunteers' uniforms; it wears well, and the retail price is 6s. per yard. Scoured wool, prepared for Nelson cloth manufacture. Hinau bark (*Elcocarpus hinau*), used in dyeing the Nelson cloth; dyes a brown-black colour.

Preparations of New Zealand flax (*Phormium tenax*), for paper manufacture, and for fibrous manufacture, are shown. Hops, wheat, oats, &c., are included in the exhibits.

Photographic and panoramic views of scenery, and reference and geological maps should not be overlooked.

New Zealand obtained four medals for wood, one for machine-made buckets, two for wood carving, one for wood turning, and one for a loo table, besides seven for rope, flax, and dyeing bark. There are also four medals given for wool, one for oats, and two for kauri gums, besides two for collections of ferns.

Messrs. Combes and Daldy, of Auckland, show some excellent strong cotton, very clean, and worth 13*d*. to 15*d*. per lb. collected in the South Sea Islands. Mr. E. King also sends a sample from the Fejee Islands of very good strong cotton, fully equal to middling Orleans, at 13*d*. per lb.

The exhibitors do not give any information respecting the quantities which could be produced; there can, however, be no doubt about the qualities being very good.

There are some interesting views of the boiling springs. These are described by Mr. Heapy.

The Tarata Boiling Springs, Rota Mahana, New Zealand.—The Crater Hill is about 100 feet high, and has broken out on the north-west side. The water descends by a series of marble-like terraces, formed of the siliceous deposits of the water. Many of these terraces are hollowed out, and contain pools of a beautifully blue water, varying in colour from an opal blue to the tint given by sulphate of copper, as seen in the bottles in a druggist's window. Several of the pools are of a semicircular form, and stand like the marble basin of an artificial fountain; the deposit forming a boss or rim projecting outwards, and hanging down with stalactites.

The Manuku shrub (*Leptospermum scoparium*) grows freely in the midst of the deposit, and appears to derive a peculiar greenness from the warm moisture of the air. Enormous volumes of steam of a dull green colour hang about the crater, and envelope the boiling reservoir. From a tepid temperature at the base of the hill, the water becomes gradually warmer on ascending, and the natives choose the most agreeable bath, and remain in it for hours at a time. The volume of water, the masses of steam, and the degree of heat, are very much increased during continuous easterly winds.

Intermittent geysers, and jets of steam, with noises like those of the workings of numerous high-pressure steam-engines, occur at intervals over the country from Tongariro volcano to Rotorua, a distance of 70 miles.

From these there are siliceous incrustations exhibited.

Sulphurs are exhibited from White Island crater.

White Island (Whakari), an active volcano in latitude 37° 30′ N., and longitude 177° 12′ E., lies off the depth of the Bay of Plenty, 28 miles from the shore. It is about 3 miles in circumference, and 860 feet high; the base of the crater is 1½ miles in circuit, and level with the sea; in the centre is a boiling spring about 100 yards in circumference, sending volumes of steam full 2,000 feet high in calm weather; round the edges of the crater are numerous small geysers, sounding like so many high-pressure engines, and emitting steam with such velocity, that a stone thrown into the vortex would immediately be shot into the air.

Here and there are lakes of sulphurous water, dormant; but the whole island is so heated as to make it dangerous to walk.

CANADA.

Number of Exhibitors, 194.

SITUATION IN BUILDING.—*At the North end of the North-eastern Transept, occupying the centre and the eastern side.*

The admirably-planned Catalogue of the economic minerals of Canada reflects high credit on Sir William Logan, by whom it was prepared, and by whom, indeed, the whole collection was arranged. To that Catalogue those interested in the mineral produce of this important colony are referred, and its existence is the best excuse which can be offered for the brief account of the Canadian minerals which follows.

Iron.—Bog iron ore is exhibited from the Radnor forges. The ore with which the Radnor furnaces are supplied, is derived from the seigniories of Cap de la Madelaine and Champlain, where it occurs close to the surface, in a multitude of patches distributed over the country with a thickness of from 3 to 24 inches. It is brought to the furnaces, partly by the workmen of the Company, and partly by the various farmers on whose lands the ore occurs. The chief manufacture of the Company consist of cast-iron car wheels, the price of which at the forges is two and five-eighths cents per lb. They have sent to the Exhibition a pair of railway wheels, and axle, which have run 150,000 miles.

Bog ore is also sent from Vandreuil and from St. Vallier.

Red hematite, or oligist ore, are exhibited from MacNab, Sutton, and Brome.

Numerous examples of magnetic ore will be found in this collection; and there is a remarkable specimen of Ilmenite with Rutile, from St. Urbain, Bay St. Paul, where there is a bed of ore 90 feet thick, which is exposed for 300 feet on the strike, and is traceable for about a mile. The ore has yielded to analysis:—

Oxide of titanium	48·60
Protoxide of iron	46·44
Magnesia	3·60
	98·64

In some parts of the bed, Rutile is disseminated in the Ilmenite in small red crystalline grains. The ore is interstratified in anorthosite rock.

Lead Ore.—Galena is exhibited from Gaspé, Indian Cove, Upton, the Ramsay mines, Lansdown, and Bedford.

Copper.—There are eighteen exhibitors of copper ore in the state of sulphide, and three exhibitors of native copper. Many of the sulphides are very remarkable specimens, both for beauty as minerals and for their richness of produce.

It is not practical, in this place, to enter into any description of the several mines, well executed-plans of most of which are exhibited. The rate of production shows that a most important mining district is being opened out.

The quantity of copper obtained from the Bruce Mine, Lake Huron (since its opening in 1847), is stated to be about 9,000 tons of 18 per cent. The quantity in 1860 was 472 tons of 17 per cent.

The quantity obtained from the Wellington Mine, since 1857, is a little over 6,000 tons of 20 per cent; in 1861, the quantity was 1,175 tons of 19 per cent. From the Huron Copper Bay Mine, probably about 1300 tons. The total quantity from the Acton Mine, up to the end of 1861, from 1859, is said to be nearly 6,000 tons, average about 17 per cent. of copper.

Nickel.—The sulphide of nickel, from Orford, is interesting. It is associated with a band of Serpentine, which runs along the east side of Brompton Lake, in Orford: there is a pale green pyroxenic rock, in which occur druses, lined with large twin crystals of white pyroxene, and with cinnamon-coloured garnets. Large masses of calcspar, probably filling a vein, are here met with, sometimes nearly pure white, and cleavable, at others penetrated and filled with small emerald-green crystals of a chrome garnet and *millerite*, sulphide of nickel.

Silver.—Native silver is exhibited from Bruce's Location, Lake Superior.

Gold.—This precious metal is exhibited from Fief St. Charles, seigniory of Aubert de l'Isle; from the seigniory of Vandreuil, the Rapids of Chaudière, and from Leeds, where the gold occurs in grains in Bitter Spar.

It has long been ascertained that the drift of the south side of the St. Lawrence, in Canada, from Lake Champlain to the Etchemin, and probably to the extremity of the province in Gaspé, is auriferous; the area being about 15,000 square miles. Gold has been washed from this gravel on the St. Francis in Melbourne, at Sherbrooke, in Westbury, Weedon, and Dudswell, and on Lake St. Francis; as well as on the Chaudière and the Etchemin, and their tributaries, from the sources of these rivers nearly to their mouths. Various companies have made trials of this drift in several places, one of the most important having been on the Rivière des Plantes, in the seigniory of Vaudreuil (Beauce); but of this it is not easy to procure authentic details. In 1851, the Canada Gold Mining Company commenced a trial of the drift along the Rivière du Loup, near its junction with the Chaudière, in the seigniory of Aubert de l'Isle; which continued three years. The specimen exhibited was obtained by the workings of this company.

GOLD from RIVIÈRE DU LOUP.

Years.	Area washed.	Gold collected.	Value.	Wages.	Profit.
	Sq. acres.	dwts. grs.	S.	S.	S.
1851	$\frac{3}{8}$	2107 11	1826·46	1644·33	182·13
1852	$\frac{5}{8}$	2880 19	2496·69	1888·35	508·34
		4987·30	4323·15	3532·68	690·47

Specimen No. 2, a nugget of 80 dwts., is from Vaudreuil. In this specimen the proportion of gold is 64 per cent. It was obtained from the drift of the Rivière des Plantes, a tributary of the Chaudière. Many of the small masses of gold which have been obtained from the drift of the Chaudière valley, being of a character somewhat similar, there cannot be much doubt that the drift gold of the region has been derived from quartz veins, situated, probably, somewhere not very far distant.

Platinum and Iridosmine are sent from the Fief of St Charles. The grains have been separated from the gold drift.

Ores of Chromium, Molybdenum, and Cobalt, are also exhibited.

Petroleum, or Rock Oil, is exhibited by the Canadian Oil Company, from Enniskillen; by Watkins and Inglis, from Tilsonburgh, and by the Geological Survey, from Bertie; also bituminous shale from Collingwood.

Natural springs of rock oil have long been known in several localities in Western Canada. Two of these are in the township of Enniskillen, in the southern part of which are two patches of an acre or more, covered with a layer of several inches of viscid mineral tar or asphaltum, which has resulted from the drying up of the petroleum of these springs. Wells sunk in their vicinity, to a depth of from 40 to 60 feet, through the superficial clays, encounter a stratum of gravel, resting on the surface of the rock beneath, and often filled with oil; giving origin to what are called surface wells. On boring into the underlying soft fossiliferous shales and limestone, fissures are met with at various depths, from which rise abundant supplies of oil, often accompanied with inflammable gas, and with water, which is sometimes saline. These fissures, which also supply the surface wells, are apparently connected with the oil-bearing strata of the Corniferous limestone; which is from 200 to 300 feet below the surface, in Enniskillen. Within an area of about 4 square miles in the first three ranges of this township, there were supposed to be, in August, 1861, about seventy wells, yielding more or less oil. Of these forty were surface wells, that is, wells sunk from 40 to 60 feet, through the drift clay and gravel, to the rock beneath. Some of these latter, which had yielded but little oil, gave abundant supplies by boring into the rock. The oil-bearing fissures or veins, in adjacent wells, were met with at depths varying from from 36 to 100 and even 150 feet from the surface of the rock. One of the most abundant occurred at 60 feet. In some few cases the oil from the borings rises above the surface of the ground, constituting what are called flowing wells.

It is not easy to know the amount of oil which these wells are capable of supplying, since from the great difficulty in getting it to market, arising from the want of good roads, few of the wells are regularly and continuously pumped. Some of those which were bored in July and in August last, are said, upon good authority, to have yielded from 400 to 500 barrels of oil, in a week or two after having been opened; but the reservoirs provided, being filled with oil, the pumping of the wells was suspended. Two bored wells, belonging to Mr.

Williams, which were the only ones continuously wrought in August last, are said to have yielded together, during some months, from 20 to 25 barrels (of 40 gallons each) daily. About six miles to the northward, at Petrolia, on lots 13 and 14 of ranges 10 and 11 of the same township, sixteen wells had been sunk last August, of which twelve were surface wells, and had yielded large quantities of oil. Several of these had been wrought for nearly twelve months, and were supposed in that time to have yielded 1000 barrels. Other wells had recently been bored to a depth of nearly 200 feet, but yielded less oil than the surface wells. The wells of this region seem, thus far, to be less important than those in the southern part of the township. The oil from the deep or rock is somewhat lighter and more fluid than that from the superficial wells, which is very dark coloured and somewhat viscid.

Great expectations have recently been excited by a flowing well, known as Shaw's, which was sunk to a depth of 200 feet; and when first opened, a few weeks since, was supposed to yield, for a short time, 2000 barrels of oil in 24 hours, which flowed into a stream near by and was lost. This well is however said to have been since closed, so that the discharge is under control. Another recent well, near by, known as Bradley's, is nearly as abundant. The experience in Pennsylvania has, however, shown that the supply from these flowing wells soon diminishes, and eventually fails. Adjacent borings sometimes appear to be connected with the same oil-yielding fissure, and to affect each other's supply; in some cases the air passes down one shaft when the other is pumped.

The oil-bearing beds of Bertie are made up in great part of corals, in the pores of which the oil is lodged, like honey in a comb. The oil-bearing limestone underlies an area of 7000 square miles in Western Canada. It is of marine origin, and contains no organic remains but those of marine animals; so that we are led to believe that these hydrocarbons have been derived from a peculiar decomposition of their tissues.

Phosphate of lime (apatite) is exhibited from two localities, North Elmsley, and South Burgess.

Marbles, building stones, and clays, are also exhibited in considerable variety, with several refracting minerals of an interesting character. Plumbago is sent from Pointe du Chêne Graphite Mine, county of Argenteuil, from Grenville and Lochaber. It is usually found disseminated. It occurs also in beds in sufficient purity and quantity to be economically available. The workable beds, which have been observed, are chiefly in various townships on the north side of the Ottawa. They occur in many localities, at considerable distances from one another, but several of the exposures are probably repetitions of the same bed.

Roofing slates form a conspicuous feature amongst the Canadian minerals. The Walton quarry, Melbourne, contributes largely. The analyses given by T. Sterry Hunt, F.R.S., show that the slates of Melbourne very closely resemble those of Wales.

Clay manufactures are an interesting group.

Grinding and polishing materials, mineral manures, mineral paints, minerals applicable to the fine arts, and minerals applicable to jewellery, with the miscellaneous group, all show the importance of the mineral wealth of Canada; and, seeing that by far the largest number of specimens are contributed by the Geological Survey of Canada, this collection speaks loud in favour of the Director of that Survey, Sir William Logan.

The crystalline rocks of Canada exhibited are intended to illustrate some points in the natural history of these formations: they are arranged and described by T. Sterry Hunt, F.R.S., and the specimens, with the descriptive catalogue, are of high scientific value.

CANADA—*continued.*

The Lower Canada collection, prepared under the superintendence of Dr. Taché, of Quebec, consists of—1. Specimens of trees, and forest shrubs, with the branches, leaves, and flowers, prepared for study:—of commercial woods, in the usual market form:—of the natural productions of the waters and forests, employed in the arts and in pharmacy:—of the most useful species of fish, in a preserved state:—of productions derived from cetacea and fish; and of the principal furs of the wild animals.

CANADIAN WOODS.—The woods are as follow—

1. Collection made at St. Joachim, in the neighbourhood of Quebec, lat. 47°, about 130 leagues from the sea. This collection, which serves as a basis to all the specimens of trees and shrubs exhibited, is composed of 66 specimens of woods.

2. Collection of 54 specimens of woods, obtained in the county of St. John, lat. 45°, about 200 leagues from the sea, by Mr. F. Prieur.

3. Collection of 31 specimens of woods, obtained at Remonski, lat. 48°, about 80 leagues from the Gulf of the St. Lawrence, and on the banks of the salt waters of the lower part of the river, by J. B. Lepage.

4. Collection of 48 specimens of woods, from the county of St. Maurice, lat. 45° 30′, about 170 leagues from the sea, by Dr. Dubord.

5. Collection of 41 specimens of woods, obtained in the county of Ottawa, on the Gatineau River, lat. 45° 30′, about 220 leagues from the sea, by Dr. Dubord.

6. Collection of 41 specimens of woods, obtained in the county of Chicontimi, lat. 48° 30′, about 100 leagues from the sea, by Mr. D. Price.

These collections comprise in all 74 distinct species and varieties, which are nearly all that are to be met with over the whole surface of Lower Canada, with the exception of the extreme north.

The commercial woods are from Messrs. Duncan, Patton, and Co., who exhibit a full collection of Canadian market timber, and Mr. G. Gingras, of Quebec, exhibiting some choice specimens of sawn wood.

Square and manufactured timber is exported in large quantities from the different ports of the coast of Gaspé. There is also found an abundance of wood of the best quality for shipbuilding purposes. The lands in the district of Gaspé are composed of a light but fertile soil, producing all kinds of grain and vegetables. There are millions of acres of those lands which are still in the wild state and covered by beautiful forests.

Messrs. Tourgron and Ouellet, of Quebec, are exhibitors of preserved fish, salmon, tunny, cod, eel, and sardines.

Mr. C. H. Tetu, of River Ouelle, is an exhibitor of skins and oils of the cetacea, and fish from the lower part of the river—the seal, white porpoise, shark, and cod-liver oil.

Mr. Olivier Giroux, druggist at Quebec, exhibits vegetable and animal productions in use in the arts and pharmacy, 13 in number; and Mr. O. Côte exhibits 19 specimens of furs of animals of Lower Canada, which include the moose deer, bear, red fox, black and red marten, beaver, peccan, racoon, minx, otter, lynx, skunk, marmot, musk rat, &c.

Fisheries.—The fisheries belonging to the province are attracting much attention, and will no doubt prove a productive source of wealth. They are inexhaustible, and are now subjected to a regular system of licensing. Inspectors have been recently appointed, and every endeavour is being made to preserve them and encourage their increase. They are but as yet in their infancy, and a brief statement of them is here given, showing their extent and their value even in the very limited use of them now made.

Lower Canada possesses, in the River and Gulf of St. Lawrence, an extent of coast of 1000 miles, where the cod, herring, mackerel, salmon, and other fisheries are carried on successfully. Whale fishing is also carried on by vessels fitted out from the port of Gaspé. The average season value of whale oil has been about 27,000 dollars.

The cod fishing is carried on along the whole shore of Canada. The herring fishing principally at the Magdalen Islands, in the Bay of Chaleurs, and on the coast of Labrador. The mackerel fishing at the Magdalen Islands, along the coast of Gaspé, and in the lower part of the River St. Lawrence.

There are above 70 salmon-fishery rivers in Lower Canada, which the Government are now fostering, with a view to enhance the commerce in this valuable fish. The latest annual catch was 3,750 barrels. The Bay of Chaleurs alone formerly exported 10,000 barrels.

The number of boats belonging to Canada, fishing on the Canadian shores, is from 1200 to 1500. Nearly 100 Canadian vessels are employed in the fisheries of Canada.

The number of fishing vessels from Nova Scotia and the other lower provinces, fishing on Canadian shores, is from 250 to 300. The number of fishing vessels from the United States, frequenting the Canadian shores, principally for the cod and mackerel fishing, is from 200 to 300.

Quantity of dried and smoked fish yearly exported - - - - - - - - -	846,567 Quintals.
Quantity of pickled fish exported - - -	118,257 Barrels.
Consumed in Canada, above kinds - - -	75,000 Quintals.
Quantity of fish oil exported from Canada -	100,218 Gallons.
Number of seal skins ditto ditto - -	12,000
Quantity of salmon taken in the rivers of Canada - - - - - - - - -	3,750 Barrels.
Quantity of trout and halibut taken in Canada	900 Barrels.

Total fish productions, valued at 942,528 dollars.

The take by vessels other than Canadian is not computed in this table.

The merchantable fish products derived from the lakes and rivers of Upper Canada consist chiefly of white fish, salmon, salmon-trout, herring, lake-trout, speckled-trout, sturgeon, pickerel, bass, maskinongé, &c. Inferior kinds also abound in the smaller lakes, tributaries, and streams.

The extensive area, great depth, clear, cold waters, abundant feeding banks, shoals, and spawning grounds, of the principal Upper Canadian lakes, render the fish found therein numerous, of good quality and large size. The annual take of the different species of fish is carefully estimated at 380,000 dollars value. This produce is variously disposed of, by export, fresh, and cured, to the neighbouring United States, and for domestic sale and consumption.

Ready markets are found, both at home and abroad, for any seasonable catch.

Tracts of arable land, bordering on the great Lakes, are still at the disposal of the Government for sale and settlement.

WOODS OF UPPER CANADA.—These have been collected from the extreme eastern and western, and central parts, for the purpose of showing the extent of country over which the most valuable timbers grow.

1. The most important collection is in the form of planks, 12 feet long and 4 inches thick, with the bark on both edges. Of these (sixty in number), there are superb samples of white oak, 4 feet wide; white wood, black cherry, black walnut, button-wood, white ash, sugar maple and soft maple, from 3 to 4 feet wide; one plank of pine, from the township of Bayham, 12 feet long (and it could have been cut 50 feet long) and 50 inches wide, without a knot, sawn from a tree 22 feet in circumference and 120 feet to the first limb; the first four logs, 12 feet long, making 8,000 feet of lumber after being squared.

2. The second class of woods are sections of the trunks of the chief of the valuable timbers, with the bark on, taken from the three divisions of the province above named. Of these there are thirty-four.

3. The third are neatly planed and polished specimens of all the chief woods—one side varnished, the other plain—veneers of the plain wood, of crotches, of roots, &c., of the most choice varieties. Of these there are two collections, each of 73 specimens, with some smaller ones; in all about 250.

4. The fourth class consists of the sections of the trunks (from 3 to 6 inches in diameter), 1 foot long, with the bark

on, so cut as to show the grain of the wood and the polish it will take, accompanied with twigs, leaves and flowers of the trees. In this class are five valuable collections, from the most distant parts of Upper Canada, of some ninety distinct kinds of native woods and shrubs. Of these there are 203 pieces.

The common and scientific names of all the woods are given, with the size and height of the trees, the specific gravity of the wood, its weight compared with shell-bark hickory (which, being the heaviest of all the Canadian woods, is taken as the standard), its uses, prices at the Lake Ports and at Quebec, &c.

5. The fifth class contains samples of tool handles, shafts and poles of carriages, spokes, naves, &c., showing the common purposes for which the woods are best adapted and most used.

From a pamphlet issued from the Bureau of Agriculture, at Quebec, we learn that Canada exports annually about 30,000,000 cubic feet of timber in the rough state, and about 400,000,000 feet, board measure, of sawn timber. The revenue derived by the province, during 1860, for timber cut in the forests, amounted to about 100,000*l*. Of the sixty or seventy varieties of woods in the forests of Canada there are usually only five or six kinds which go to make up these exports, so vast in quantity; the remaining fifty or sixty timber trees are left to perish or are burned as a nuisance, to get them out of the way. By showing, in the markets of the world, that they have these valuable woods, and can furnish them at such unprecedentedly low prices, they will secure additional purchasers. The collections here named, were made chiefly in reference to this point, and are, in their nature and in their intrinsic value, it is believed, well adapted for that purpose.

In extent, in the variety and value of its woods, the great forests of deciduous trees of North America surpass all others; and the most remarkable of this great mixed forest is that growing in the valley of the St. Lawrence. The western coasts of both continents, in high latitudes, furnish only or chiefly the Coniferæ. The high summer temperatures and abundant summer rains are, unquestionably, those conditions of climate necessary to produce these peculiar forest trees. The western coasts of both continents, in high latitudes, have the necessary moisture, but not the high summer temperature; the western prairies, east of the Mississippi, and the vast deserts west of it, have the summer heat but not the moisture; hence the absence of all trees in the one region, and of the deciduous trees in the other.

If the people of Canada had a more correct appreciation of the riches which they possess in these mighty forests, they would not surely so unnecessarily destroy them.

To the collections above named there are to be added the following:—

One hundred and thirty-two specimens of native medicinal herbs and roots; fifty-three pint-bottles of fluid used in the practice of medicine, and twelve different specimens of perfumery; the fluids and perfumery are manufactured by the contributor, W. Saunders, of London, Canada.

One hundred and fourteen coloured plates (natural size) of fruit grown in Upper Canada in the open air, prepared by the Fruit Growers' Association of Upper Canada.

One case stuffed native ducks, twenty-two varieties; one case containing one hundred and ten other birds (native,) stuffed; one case containing one hundred and three birds found on the Island of Montreal, by James Thomson, of Montreal; one case containing thirty-six fishes from the lakes and rivers of Upper Canada, by S. W. Passmore, Toronto. The chief fishes are the salmon-trout, white fish and herring from Lakes Huron and Ontario; the sturgeon, maskinongé, pike, pickerel, sucker, (white and black), black bass, rock bass, sunfish, perch, and several smaller varieties. The first three kinds are found only in the large lakes, Ontario, Erie, Huron, and Superior, except the herring in one or two of the smaller lakes; the others, except the sturgeon, also swarm in great numbers in all the smaller lakes, and in many of the smaller rivers. The salmon from the ocean also ascends to the head of Lake Ontario, 1200 miles from the Atlantic. Great quantities of the salmon-trout and white fish are exported, amounting in value to from $500,000 to $1,000,000 annually. Samples, also, of the preserved fish, salmon-trout, white fish and herring from Lakes Huron and Ontario have been obtained.

Flax cultivation is beginning to extend in Canada, and there are samples of flax seed shown, of which 20 to 25 bushels were obtained, and 400 to 500 lbs. of scutched flax; various samples of wheat 30 to 32 bushels to the acre, barley 35 and 45 bushels, Indian corn 25 bushels, oats 80 bushels, rye, pulse, and other agricultural seeds are also shown; and cakes of unrefined maple sugar as ordinarily made by farmers.

A reference to the display of cereals and other agricultural productions made by Canada, at the Exhibitions of London and Paris, might be considered sufficient to illustrate the remarkable adaptation of the soil to their growth and cultivation; but so limited a notice would leave the question of permanent fertility still unanswered. When, however, it is known that the area in which the astonishing crops of wheat are raised, for which Upper Canada is so justly distinguished, extends over three-fourths of the present inhabited parts of the country, and that the prevailing soils consist of rich clays of great depth, the question of permanent fertility resolves itself into that of husbandry.

In the valleys of some of the largest rivers of Upper Canada, wheat has been grown after wheat for twenty years: the first crops yielded an average of 40 bushels to the acre, but under the thoughtless system of husbandry then pursued, the yield diminished to 12 bushels to the acre, and compelled a change of system, which soon had the effect of restoring the land to its original fertility. This system of exhaustion has effected its own cure, and led to the introduction of a more rational method of cultivating the soil. Years ago, when roads were bad and facilities for communicating with markets few and far between, wheat was the only saleable produce of the farm, so that no effort was spared to cultivate that cereal to the utmost extent. Now, since railroads, macadamized roads, and plank roads have opened up the country, and agricultural societies have succeeded in disseminating much useful instruction and information, husbandry has improved in all directions, and the natural fertility of the soil of the old settlements is in great part restored.

The average yield of wheat in some townships exceeds 22 bushels to the acre, and where an approach to good farming prevails the yield rises to 30 and often 40 bushels to the acre. On new land 50 bushels is not very uncommon; and it must not be forgotten that Canadian wheat, grown near the city of Toronto, won a first prize at the Paris Exhibition. It may truly be said that the soil of what may be termed the agricultural portion of Canada, which comprises four-fifths of the inhabited portion, and a vast area still in the hands of the Government and now open to settlement, is unexceptionable; and when deterioration takes place, it is the fault of the farmer and not of the soil. In Canada the yield of wheat in 1859 considerably exceeded 25,000,000 bushels; and the quality of Canadian wheat is so superior, that the American millers buy it, for the purpose of mixing with grain grown in the United States, in order to improve the quality of their flour, and in some instances to render it fit for exportation. The returns for 1860 are not published, but the results are known greatly to exceed those of 1859.

The collection of manufactured articles, prepared under the direction of Mr. Beatty, President of the Board of Arts, Upper Canada, and of Mr. B. Chamberlin, of the Board of Arts, Lower Canada, comprises chemical products, substances used for food, flax, wool, railway plant, manufacturing machines, agricultural implements, woollens, saddlery, iron work, and other articles too numerous to particularize: some magnificent photographs of Canadian scenery must not, however, be passed over.

The beautiful geological map of all that portion of Canada which has been surveyed by Sir W. Logan and his assistants, will be admired by all who can understand the labour expended in its production. Many manufactures are exhibited, with stationery, books, &c., all showing the steady progress made by this important colonial possession.

NEW BRUNSWICK.

Number of Exhibitors, 36.

SITUATION IN BUILDING.—*In the centre of the North-east Transept, immediately adjoining Canada.*

The only example of mineral produce of any interest sent from this colony, is the Albertite coal, which is one of those natural products possessing peculiar properties, so that there has been considerable discussion as to whether the Albertite was to be regarded as a coal or a fossil resin. The Westmoreland and Albert Company has given the geologist the means of determining the age of this formation by contributing from their mine some good specimens of fossil fish. Dr. Wolfe Spurr sends some oils from coals, and Mr. G. Matthews a case of minerals. There are a few good examples of industries connected with mineral produce, such as horse-shoes, exhibited by Mr. Scrymgeour; nails, by Mr. N. H. Scovil; a stand of brass castings, by Mr. C. Pearce; circular saws, by Mr. C. Blackton; carriage and railway springs, by Mr. W. H. Adams; and a cast-iron enamelled mantelpiece is exhibited by Mr. J. Harris; while Fleming and Humbert, of the Phœnix Foundry, contribute a well made oscillating steam-engine.

Amongst a miscellaneous collection from this colony,—containing agricultural and other implements, some textile fabrics, and ingenious manufactures from cones,—will be found many things of considerable interest. The models of bridges, and of the steering apparatus, are good examples of engineering skill and of mechanical ingenuity.

Timber.—The principal article of export from New Brunswick is the produce of her forests. In the manufacture of lumber thousands of her people are engaged, and a large amount of capital is invested. To such an extent is this business prosecuted, that it has been proved to a demonstration that New Brunswick can produce more lumber of certain kinds than there is a demand for in the British market.

Some idea of the extent of this trade may be formed from the subjoined statement of lumber—the growth, produce, and manufacture of this province—exported in 1858, a year of great commercial depression:—

Article.	Quantity.	Value.
Boards, scantling, and plank, exceeding nine feet long	13,116,000 feet.	£24,921
Boards not exceeding nine feet	5,710,000 „	7,454
Clapboards	309,000 „	1,002
Deals exceeding nine feet long	198,718,000 „	377,944
Deals not exceeding nine feet	10,067,000 „	14,561
Ship knees	138 „	138
Laths	25,714 „	5,618
Lathwood	1,045 cords.	1,045
Pickets	63,619,000 pcs.	4,895
Box and hogshead shooks	123,747	12,532
Door and window materials	100,000 feet.	815
Staves	60,480	114
Sleepers	10,222	391
Shingles	36,260 m.	11,319
Spars and masts	61,452	2,066
Birch Timber	13,732 tons.	15,084
Spruce Timber	361	320
Pine Timber	32,135	81,871
	Total value	£563,090

There are several small items not included in the above list; but an idea may be formed of the value of the timber trade, when it is stated that the above sum represents more than half the value of the other exports of the province (for the same year) put together, excepting of course the value of newly-constructed ships.

In 1852, 223,676 tons of shipping were employed to convey the lumber exported from the port of Saint John and out ports; in 1856, 281,821 tons were employed; in 1858 (the year for which the figures are given above), 195,528 tons were employed;

in 1859, 275,012 tons—showing an increase in the tonnage in the last year of 79,484.

The *quality* of the timber sent from New Brunswick is of the finest description, a fact to which even the lumber manufacturers of Canada bear testimony.

For many years to come, New Brunswick will continue to export timber and lumber in considerable quantities, her capacity for doing so being as yet almost undiminished.

The principal exports are spruce, pine, and birch; but the province produces hacmatack, fir, maple, cedar, butternut, oak, ash, and a variety of other woods, all of which are used in a greater or lesser degree in the manufacture of articles of home consumption.

It may be well to mention also that in addition to the timber exported and specified above, large quantities of pine, spruce, and other woods are used in the erection of houses and the building of ships in the province, which should be taken into account when speaking of the productiveness of its forests.

The fisheries of New Brunswick are exceedingly valuable, but they, like the mineral wealth, are comparatively undeveloped. Indeed, owing to the attention given to lumbering, no other branch of industry, except that of shipbuilding, may be fairly said to be developed at all. With the frontage which New Brunswick possesses upon the sea, it is apparent that the facilities afforded for carrying on the fishing business are very great; and though these facilities have been neglected in the past, it is believed that the apathy which existed concerning them is fast being dispelled. The provisions of the Reciprocity Treaty extend to the people of the United States a participation in the fisheries around the coast of British North America, and they have not been slow to avail themselves of the wealth thus opened up to them. Their success seems to have had a good influence upon the provincial fishermen, who, now that they have an able competitor, are determined at least to enjoy a share of the treasures before neglected, and in a few years, it is believed, the deep-sea fishery will be as actively prosecuted by colonial as it is now by American fishermen.

There are several fishing stations belonging to New Brunswick upon the Gulf of St. Lawrence and the Bay of Fundy. The total value of the fish of every kind taken annually may be estimated at about 150,000*l.* sterling, a little more than one-quarter of what it should be. The fish exported in 1858 was valued at 50,564*l.* sterling, but the actual value is considerably in excess of this sum, as many of the vessels engaged in fishing proceed direct from the fishing grounds to the United States, and no account can be kept of their cargoes or the value of them.

The principal fish are the salmon, shad, and gaspereaux—the alewives of commerce—codfish, pollock, hake, herring, and mackerel. The salmon fishery is very valuable; as many as 40,000 salmon have been taken in the course of a single season at the mouth of the Saint John, a large portion of which are sent fresh to the United States and command remunerative prices. At the entrance to the Miramichi 400,000 lbs. of salmon are annually put up "preserved" for export. Gaspereaux and shad fishery is next to the salmon, and like it may be termed "in-shore fishing," as the fish enter the fresh water to spawn, and are taken in weirs along the shores of the bays and rivers, and in drifting nets a short distance from land, in almost fabulous quantities.

Fishing for codfish, hake, and the other mentioned fish (except herring, which is also taken along the shore), may be termed "deep-sea fishing." It requires more capital and more labour than the other; but it can be made very productive. "In-shore fishing" is vigorously prosecuted; but few are engaged in the other branch.

Shellfish of various kinds, such as oysters, lobsters, &c., abound; while the rivers are stocked with fish of the usual fresh-water varieties. In addition to the fish named many other kinds are taken, some valuable as food, and others only for the manufacture of oil.

NOVA SCOTIA.

Number of Exhibitors, 65.

SITUATION IN BUILDING.—*A Court on the West side of the North-east Transept, and a space opposite to it in the centre of the Transept.*

This colony makes a noble display of its products on this occasion, regardless of expense, which reflects high credit on the spirit and enterprise of the exhibitors.

The mineral resources of this colony are satisfactorily shown.

The coal fields of Nova Scotia are well represented by seven large specimens from different localities, the most remarkable being coal from the Albion Mines, Pictou, exhibited by J. Scott, Esq. This vein is one of the largest in the world; its vertical section being from 33 to 36 feet, and its qualities excellent for the following purposes: generation of illuminating gas, and of steam, for manufacturing and domestic purposes. It is the property of the General Mining Association, and is worked by them to the extent of about 70,000 tons per annum.

There are also samples of coal from the Sydney Mines, the Lingan Mines, Glace Bay, and the Fraser Mine, with some oil coal from Fraser Mine, and from Patrick's Mine.

The amount of coal raised in 1860 at Pictou, was 165,055; Sydney, 100,098; Lingan, 35,300; Joggins, 5,295 tons. In 1861 at Glass Bay, 7,652 tons.

Large quantities are also raised at other localities, but the above are the chief works in the Province.

The Fraser Oil Coal has been mined to some extent, 2000 tons having been raised in 1859. This substance gives an average yield of about 70 gallons crude oil to the ton, while picked samples give 199 gallons to the ton.

Gold.—In 1861 it was satisfactorily proved that gold exists in Nova Scotia in large quantities. The discovery of rich leads at Tangier and Lunenburg induced persons throughout the province to "prospect"; and the result has been that gold has been found from the Strait of Canso to Yarmouth, the eastern and western extremities of Nova Scotia proper—extending over a district of country equal in size to almost half of England. The search for gold, as well as the works commenced, have been conducted by persons unacquainted with the subject, and yet the returns have been most encouraging.

The gold of Nova Scotia is represented by specimens purchased and exhibited by the Provincial Government, including bars, gold-bearing quartz, and gold washings. There are specimens from Tangier, Sherbrooke, Wine Harbor, Laidlaw's, Allen's, and "The Ovens," near Lunenburg; also, washings from the latter place. The total value of the gold exhibited will amount to over $10,000.

The gold is also exhibited in a manufactured state by the following pieces of jewelry, by J. CORNELIUS; a bracelet; a necklace (with figure of a gold miner at work, with a drop consisting of a Nova Scotian pearl); a massive brooch, with dolphin in centre; a brooch, made of Nova Scotian gold quartz; and also Nova Scotian amethysts and pearls; a masonic mark jewel, and a neat small brooch of Nova Scotian gold, with Nova Scotian amethyst (Etruscan style).

In addition to these the mineral collection, made under the superintendence of Professor Stone, is most instructive. There are many fine examples of native copper, copper pyrites, and carbonate of copper. Amongst the collection of iron ores we find micaceous, specular, fibrous hematite, and red hematite ores.

The iron made from the ores obtained at the Acadia Iron Works is illustrated by four specimens of Pig Iron, also by bars of iron. The amount of iron made is 1200 tons per annum, value 16*l.* sterling per ton.

There are also specimens of Acadian cutlery, exhibited in the Nova Scotian Department,—besides those exhibited in the Cutlery Department by the Acadia Iron Company from their establishment at Sheffield, in Class XXXI. The manufactures in iron are well selected and prove the existence of a steadily increasing industry.

Arsenical pyrites, manganese, lead ores, molydenum, and plumbago, are also exhibited. Amongst the earthy minerals we have gypsum and anhydrite, limestone, with marbles of several kinds, and various building-stones, including freestones and granites, mineral paints (ochres, which are found in great abundance), roofing slates, and clays.

Woods.—The collection numbers seventy-two specimens, remarkable for their durability, beauty, or singular appearance, accompanied by the leaf and cone peculiar to each.

Furs.—There is a fine collection of one hundred and thirty-seven skins, and articles made from them.

This attractive department gained for Nova Scotia the first place for furs in 1851, and gave a gold medal to the exhibitor for that year. Though in its nature diminishing as the province becomes settled, still the export for 1860 gave 20,000*l.* value, one half of which were furs produced in the province. The collection now shown at the International Exhibition is a very fine one. The fur-bearing animals represented, with one exception (the ermine), in the collection of skins and manufactured articles of the exhibitor, Mr. W. J. Coleman, are in their natural order. The classification is that of the Smithsonian Institute at Washington. There are five lynx skins (*Lynx canadensis*), common, said by Temminck to be identical with the lynx of Northern Europe, and is not diminishing in the province—a beautiful, rusty brown, hoary fur; and three wild cat skins (*Lynx rufus*). The wild cat, or Bay lynx, differs from the last in shorter fur and longer pencils to the ears; it is not so abundant as the last. Both are true lynxes.

Fishes, &c.—The fisheries of Nova Scotia are an almost inexhaustible source of wealth. Though a large portion of the population is engaged in agricultural and other pursuits, the exports of fish in 1860 amounted in value to $2,956,788. The Census tables give 396,427 quintals of dried fish, and 283,273 barrels of pickled fish.

The shipping owned in Nova Scotia and employed in the fisheries, &c., in 1860, amounted to 3,258 vessels, with a gross tonnage of 248,061 tons, being almost a ton to every man, woman, and child in the province. This amount of tonnage places Nova Scotia in the rank of one of the principal maritime countries in the world, and the first as to the proportion of tonnage to population.

The fish of Nova Scotia are represented by specimens preserved by alcohol in clear glass jars, by J. M. Jones, Esq., and also by specimens of pickled, smoked, and dried fish, purchased in the market, being samples of those preserved for ordinary use or export.

The reason for the largest and best specimens not being exhibited arises from two causes:—Glasses could not be procured of such dimensions as to admit of the exhibition of halibut or of the larger specimens of some other fish, and the season, when the effort to procure specimens of fish was made was so far advanced that the best samples of many species could not be obtained.

Manufactures of Wool.—There are eight or nine exhibitors of these. In 1860 there were manufactured not less than 1,320,923 yards of cloth, or over 4 yards to every inhabitant. It is principally manufactured by hand looms, and is worth about 2*s*. per yard. Nova Scotian homespun is in great demand in Canada, as well as in Great Britain. Military men who have worn it while hunting in "the bush," often send from England for a supply. It is said that there are imitations made by machinery in Canada and England, which are much inferior to the "home-made" article. The grey homespun makes a very serviceable travelling dress.

Models, &c.—In no country in the world can ships be built so cheaply as in Nova Scotia. There is every facility for this branch of industry, the coast being in every direction indented with bays and harbours, connected with the interior by numerous rivers and lakes. Ships of from 200 to 500 tons can be built for from 3*l*. to 4*l*. per ton, and including rigging for from 6*l*. to 7*l*. In many counties the farmers occupy the leisure of winter in building vessels. This is often done by a family—one of which is the blacksmith, others the shipwrights—some haul the timber, often cut from their own land; and the vessel is frequently manned by members of the family, or at least commanded by one of them. Consequently a very serviceable species of vessel is produced at but little outlay of capital. Vessels required for the rivers or coast trade of Great Britain could be supplied by Nova Scotia at quite as low a rate as that at which old vessels are frequently purchased for that trade; and, being new, would be much more profitable to the purchaser. Nova Scotia could also supply the fishermen of Great Britain with fishing yawls at from one-half to two-thirds of the price usually paid for them.

PRINCE EDWARD'S ISLAND.

Exhibitors.—The Local Committee.

SITUATION IN BUILDING.—*Centre of North-east Transept, adjoining the Courts devoted to Canada and New Brunswick.*

This is another of the North American Colonies which sends its contributions to this Exhibition. The Local Committee has done its best to send fair samples of its agricultural products and manufactures. There is not anything calling for special attention. The products correspond in a great degree with those of the adjoining British Provinces.

NEWFOUNDLAND.

Number of Exhibitors, 22, including the Government.

SITUATION IN BUILDING.—*Under Eastern Gallery, North-east Transept.*

Population, 120,000. Imports 1859, 1,323,288*l*. Exports, 1,357,113*l*.

Minerals.—It is only of late years that the colony of Newfoundland has been explored for mineral deposits, but already valuable discoveries have been made, notwithstanding the difficulties in the way of a thorough survey. No inhabitants live five miles inland from the sea-board, the interior of the island being alternate woods, marshes, and barrens, and about one-eighth covered with lakes and gullies. Near the shore the land is much split up in ravines, deep bays, and arms of the sea forming numerous fine harbours. It was through the most difficult section of this region that the electric telegraph route was first surveyed, and then the line constructed by Frederic Newton Gisborne of Sydenham, an engineer and electrician, well known in America, and to whom the British and North American colonies are indebted for electric connection, and Europe for late intelligence, *viá* Cape Race. For this hazardous service so successfully accomplished he was presented with a silver statuette by the inhabitants of Newfoundland. To this pioneer, and also to the Hon. C. F. Bennett, of St. John's and Bristol, is the colony mainly indebted for mineralogical researches, most of the specimens to which attention is now called having formed part of Mr. Gisborne's cabinet.

		Assay.	
1.	Grey oxide of copper, from Brigus	70	per cent.
2.	Peacock copper from Brigus	30	"
3.	Yellow Sulphuret copper from Bonavista	20	"
4.	Ditto Ditto from Trump Island	12	"
5.	Peacock copper from Great Placentia	18	"
6.	Yellow sulphuret from Duck Island	12	"
7.	Ditto from Sunday Cove Island	10	"
8.	Ditto from Bishee	10	"
9.	Grey oxide from Stony House	25	"
10.	Yellow sulphuret from Paquet	10	"
11.	Green carbonate from Brigus	50	"
12.	Mundic with yellow sulphuret from Terra Nova and Little Bay	6 to 10	"
	This is a very remarkable deposit, the lode averaging over 40 feet in width: it is being actively worked this winter, and is believed to be of great and increasing value.		
13.	Galena from La Manche	84	"
	16,000*l.* value of lead was shipped from this mine during eighteen months' work.		
14.	Silver lead from Little Placentia.		

15. Silver ores from Lawn.

1. Vitreous silver	84 per cent.
2. Ruby silver	78½ „
3. Horn silver	76 „
4. Silver lead.	
5. Quartz, rich in silver.	

This is a new discovery, and worthy of notice as indicative of the veried mineral resources of the colony.

16. Silver lead from Great St. Lawrence.
17. Iron ores from Placentia and Exploits Bay.
18. Green and white marble from Little Bay.

It will thus be seen that this colony, so easy of access and so salubrious in climate as it undoubtedly is, is well deserving the attention of the local government and foreign capitalists.

First in importance, however, among the natural productions of this, the most ancient of the British colonies, are fish and oils; of the former are exhibited the staple export, salt cod fish, and caplin, their favourite bait when living. The latter frequent the coast of Newfoundland in countless numbers during six or seven weeks every summer, and during the caplin schoole, as it is designated, the great bulk of the seasons fish (cod alone being locally designated by that name) is taken. The annual British catch is about 1,350,000 quintals, *i. e.*, cwts., or about 10,000,000 fish, and the French Bank and shore catch about half that quantity. The Bank fisheries, now almost exclusively carried on by the French, employ over 300 square rigged vessels, averaging 30 men each. A fair voyage would be abont 300,000 fish to a vessel. The British also export about 3,000 tierces of salmon and 150,000 barrels of herrings. Preserved salmon and lobsters in tins are also exhibited, and have the reputation of being reasonable in price and excellent in quality.

Oils.—Seal: Between the 1st and 15th of each succeeding March, about 400 vessels, carrying nearly 13,000 of the most hardy fishermen in the world are distributed amid the arctic floes and ice fields, drifting between the Straits of Belle Isle and St. John's, and upon which the seals bring forth their young. The catch varies according to the state of the ice and the fortune of the ice-hunters, some vessels returning with from 5,000 to 7,000 young seals, or white coats, as they are designated, within the month, and others coming in clean some weeks later. The average catch is about 400,000 seals, worth from 8*s.* to 10*s.* each, according to the market price of their fat or blubber and skins, the latter being worth about 5*s.* each. This fat is either cut up in small pieces and thrown into large vats, where, first by pressure and then from decomposition, the oil is extracted, or the whole is steamed. The white coats producing the "pale" and most valuable oil, the old seals, (harps, hoods, and square fippers,) the "straw" and coarser oils. The former being worth this year 40*l.* per tun, and the latter 36*l.* Good samples of the cold-drawn or vat oil are exhibited by Messrs. O'Dyer, and others, of St. John's, and steam-rendered oil by Messrs. Punton and Munn of Harbour Grace; the latter firm also show a new article of commerce pressed from the seal fat. It is a stearine valuable for soaps, though too soft for candles, and worth from 35*l.* to 40*l.* per ton. To Mr. S. G. Archibald is the credit due for inventing the process of steam-rendering and pressing seal fat. The cold-drawn oil when fresh and pure is, however, preferable; for the oline being retained, and almost all the stearine being precipitated, the oil remains more clear at low temperatures.

Cod-liver Oil.—Of late years since the discovery of its medicinal properties when taken inwardly and its nutritive property, great care has been bestowed upon the manufacture of this oil. The best qualities are worth 6*s.* per gallon, and are inodorous and almost tasteless, and are prepared from the liver when quite fresh, by steaming it in open copper pans, from which it is skimmed as it rises to the surface and after all impurities have been removed. Messrs. Ewin, Stabb, C. Fox, and others, show good samples of this oil; while Messrs. McBride and Kerr exhibit the common cod-liver oil of commerce, which is rendered after partial decomposition has taken place, and is worth about 39*l.* per tun.

Samples of seal refuse and fish offal deodorised manure are exhibited by Mr. C. Fox. It is prepared by amalgamation with sulphuric acid (itself a fructifier), and forms a new and most valuable fertilizer.

The island abounds in Cariboo (a species of reindeer), wolves, bears, foxes, beaver, otters, arctic hares, martins, ptarmigan, and various birds of prey, though few of song. Some beautiful silver-grey and other fox skins are exhibited, one in particular (the property of the Governor, Sir Alexander Bannerman), having apparently caught the last tints of the setting sun.

Several cases of ptarmigan and various birds, stuffed by the late Mr. Ellis, M.P. of St. John's, are also shown; also the head of a noble stag, with antlers, bearing forty-two points, shot and prepared by F. N. Gisborne.

Agriculture.—Oats, barley, wheat, and flax, grown by the Hon. L. O'Brien and John Leamon, are exhibited.

Amongst the examples of mechanical ingenuity we have —Models of a screw propeller, of a submarine tunnel, also of a vessel; Esquimaux carvings; advertising plates, &c.

Patent ship-steering signals (electric), by F. N. Gisborne, showing the several commands and replies between the commander and helmsman, together with a model wheel, showing how the rudder indicates its position to the captain: approved by the Admiralty. Mr. Gisborne also exhibits a patent railway-ticket date cutter. It cuts with ease the date in characters that cannot be altered without detection. This gentleman has also patent safety mining and telegraph signals, showing the presence of choke or fire damp in mines, both below and above ground, and an easy method of telegraphing by coloured lights.

Cochineal colouring, snake root, and poplar blossoms, are exhibited as examples of pharmaceutical products.

There is also a good map of Newfoundland (manuscript), by F. N. Gisborne, showing the principal lakes and watercourses, Indian trails, electric telegraph route to Cape Race, geology, &c. (not yet completed).

VANCOUVER.

Number of Exhibitors, 6.

SITUATION IN BUILDING.—*Centre of North-east Transept.*

The articles shown from this distant colony have an especial interest from the great similarity of the climate of the island to that of Great Britain, and from its proximity to the rich gold fields of British Columbia, which are now attracting so much attention. The exports of gold in 1851 were to the value of half-a-million sterling. The woods of this island and of the adjoining continent are of magnificent dimensions, and comprise the Douglas pine, spruce and white pine, silver fir, oak of three kinds, maple, yellow cypress, willow, hemlock, crab, dogwood, poplar, alder, yew, juniper, arbutus, cedar, &c. The Douglas pine is very superior for masts, and the cypress for boats, cabinet and joinery work, close in grain, light and elastic.

There are but two or three saw-mills in the colony: to clear the land, bonfires are made of the magnificent Douglas pine, and the principal use for the cypress is to burn the Indian dead. Great Britain annually imports some 20,000,000 cubic feet of pine from Canada. A small specimen of the Douglas pine may be seen at Kew Gardens, it forms a flagstaff 150 feet high; 175 to 200 feet is a common height. A section from one which was 309 feet in height is in the British Columbian Court. The French Government engineer at Cherbourg, M. Serres, says this wood is superior for its almost complete absence of knots; its resistance is nearly equal to, and its weight a little less than the best in use, and owing to its great size there is some gain in weight and much saving of material and cost.

Other sources of probably great profits not yet examined, are the collection of turpentine, which exudes freely from the Douglas pine, and obtaining salt from numerous strongly impregnated saline springs. Hops grow luxuriantly, but they are not cultivated; all those consumed are imported from California. Manufacture of iodine from unlimited quantities of kelp on the coast. The manufacture of hemp from the abundant hemp nettle; its quality is superior to Russian: nets, string, and rope, made from it by the Indians are shown. There is kelp or seaweed shown, partly prepared by the Indians for rope-making. There is no tannery, the leather is all imported and the hides exported—as is also the wool, for there is no loom, although the consumption of blankets is enormous.

Oils.—The Indians extract hundreds of gallons of oil annually from the whale, porpoise, and dogfish. They master the whale with a harpoon attached to a distended sealskin. The quantity of salmon is most enormous; the cod and halibut are abundant; the herring during its season can be scooped into boats with rakes. The ulahan is a fish very like smelt: it comes in myriads, and is excellent food either fresh or preserved: a gentle heat extracts an oil abundantly, which is more palatable than, and possesses all the medicinal properties of, cod-liver oil; the Indians use it as butter, and could not live without it; its collection and use are entirely confined to the natives, arising from its virtues being unknown to the civilized world. Since the discovery of gold, curing of fish for export has been neglected.

There is a case of cereals consisting of samples of wheat, barley, oats, and field peas, and Timothy seed, from farms in the vicinity of the chief town, Victoria. Also preserved fruit, vegetables, meat, and fish, smoked salmon, a stuffed buck, a pair of antlers of the Wapiti deer, and a case of native birds.

BRITISH COLUMBIA,

One of the youngest of Britain's colonies, stands here as in its true position, opposite to Vancouver. It shows a magnificent section of the Douglas pine, 6 feet in diameter, a true model of a log hut, a larger pair of Wapiti horns than even those from Vancouver, and many native dresses, skins, utensils, &c. The last item we may notice is a North American tea substitute—the Labrador or James's tea (the leaves of *Ledum Latifolium*), used as a beverage and for smoking: it possesses narcotic properties.

THE WEST INDIA COLONIES.

The West India colonies which take part in the Exhibition are British Guiana, Trinidad, Barbadoes, Jamaica, St. Vincent, and Dominica. Taking them in the order in which they stand, we commence with British Guiana.

BRITISH GUIANA.

SITUATION IN BUILDING.—*The North-east corner of the Eastern Dome in the Transept.*

This colony has one of the finest collections, including beautiful illustrations of its natural history in mounted birds, cabinets illustrative of its entomology, bottles of reptiles, skins, and stuffed animals. It is also especially rich in furniture woods, of which the beautiful jewel cabinet and circular table shown are examples.

The only minerals exhibited are magnetic iron sand, hydrated sesqui-oxide of iron, white and red clays, quartz, &c.

British Guiana sends fourteen samples of useful cottons, ranging in value from 11*d.* to 3*s.* per lb. The commissioner from British Guiana, however, does not hold out much hope of an extensive revival of the cultivation of cotton in that territory unless English capitalists will undertake to find the means of developing the latent resources of the country. Sir W. Holmes states that the colony does not now export a single bale of cotton, but that everything is ready for the production of large quantities, if parties will send agents to promote the cultivation. There are excellent roads throughout the colony, and great numbers of small farmers would cultivate it if they felt sure of purchasers for their crops when raised. At present, however, sugar offers greater inducements. Chinese labourers might also be introduced with great advantage. The cultivation of cotton is no novelty in British Guiana, for in 1803 the exports were 46,000 bales, and it is probable that we may receive 100 bales this year as the first fruits of the revival of an old trade. The great want of the colony is a middle class.

Samples.—Report and Valuation.

No. 6.	Coarse - - - - - - -	worth	12½*d.* to 13*d.*
9.	Over-ripe, reddish - - - - -	„	11*d.*
10.	Useful - - - - - - -	„	12*d.* to 13*d.*
11.	Like Brazilian - - - - -	„	14*d.* to 16*d.*
12.	Sea Island, degenerated - - -	„	12*d.*
14.	- - - - - - - -	„	11*d.*
16.	Beautiful colour, strong, coarse, and fair	„	13*d.* to 14*d.*
17.	Like No. 16; pretty regular - -	„	12*d.*
19.	Equal to fair New Orleans - -	„	14*d.* to 15*d.*
18.	Very good staple - - - - -	„	16*d.*
2.	Useful quality - - - - - -	„	12*d.*

Guiana, British, French, and Dutch, are capable of producing supplies far exceeding any probable demand for cotton. The coast lands (most favourable on account of the sea-breezes, and the opportunity of saturating the soil, during the blossoming season, for a few days with salt water) extending for at least 300 miles, by 10 in depth (say 3000 miles), would, if properly drained and cultivated with the aid of steam-ploughs, furnish a supply of at least 3,000,000 bales of cotton every year, very superior in quality to the ordinary American.

TRINIDAD.

SITUATION IN BUILDING.—*Under Eastern Gallery, North-eastern Transept.*

The Trinidad Exhibition Committee have contributed in illustration of the mineral resources of this interesting island—a collection of asphalte from the Pitch Lake; some iron ores; gypsum from St. Joseph; a tertiary coal from the eastern coast; and lignite from the Trois coast.

The hæmatite from Gasparillo contains 60 per cent. of iron, and the iron ore from Maracas contains 76 per cent. of iron.

There is a geological map of Trinidad, a section of the lignite beds, a view of the Pitch Lake, and a view of the waterfall of Maracas, exhibited by L. Barrett.

The collection of vegetable products sent from Trinidad is interesting, because it has been supervised and described by

Mr. Herman Cruger, the colonial botanist, in a scientific catalogue, which furnishes much useful information. There are about two dozen specimens of medicinal and pharmaceutical products, many of which are new to European practitioners. The food products are most important although not numerous. Several exotic products have been successfully introduced, especially the Brazil nut, cloves, nutmegs, black pepper, and vanilla. Of coffee there is now very little produced in Trinidad; but cocoa is an important staple, and there is a fine collection of the several varieties of seed, wild and cultivated, for which the island is famous. The other chief products exhibited are arrowroots and starches, rice, Indian corn, and various edible nuts and fruits. There are some interesting animal and vegetable oils worth notice, especially that from the Avocado pear, and the Carap oil.

Trinidad sends six samples of good cottons, ranging from 1*s.* per lb. to Sea Island at 3*s.*

No.	95	Middling American, worth	- -	13*d.*
	96A	Sea Island „	- -	36*d.*
	96	Middling American „	- -	12*d.*
	98	Sea Island „	- -	36*d.*
	100	„ Stained „	- -	13*d.* to 15*d.*
	99	Middling American „	- -	12*d.*

But we are not likely to receive any great quantity from Trinidad, unless English energy and capital are employed.

BARBADOS.

Number of Exhibitors, 35.

SITUATION IN BUILDING.—*Eastern side of North-east Transept.*

Barbados has but a very small collection—certainly by no means creditable to the wealth and industry of "little England;" and the pride of Barbados is certainly thrown into the shade by its insignificant exhibit. There is a small assortment of sugars; a few models of fruits, cotton, and starches. The gourds of Barbados aloes show one of the minor products of the island, whilst a sample of very fine indigo indicates another new industry.

There is one sample of very carefully-prepared cotton of beautiful staple, superior to Fair Orleans, worth 14*d.* to 16*d.* Barbados cannot produce any large quantity of cotton without throwing sugar out of cultivation. The value of the returns will, of course, regulate the supply.

JAMAICA.

Number of Exhibitors, 195.

SITUATION IN BUILDING.—*The east side of the North-east Transept, under the Gallery.*

There is a Geological Map of the eastern part of Jamaica, comprising the parishes of Port Royal, St. Thomas in the East, Portland, St. George's, and part of the parish of Metcalfe, showing the progress made in the Geological Survey of Jamaica. Scale, one inch to the mile. A General Section of the formations, examined in the east of Jamaica, showing the order of the tertiary and secondary sedimentary formations, and the interbedded igneous rocks of cretaceous age. A Section across the island of Jamaica, from Kingston, on the south side, to Annotto Bay on the north; and some photographs of the *Hope Mine*, St. Andrew's (lead and zinc), by J. Savage, Esq.

Mr. Lucas Barrett has made a good collection of the economic minerals of Jamaica. The more important being—

Iron Ores.

Magnetic iron sand, Annotto Bay, Metcalfe.
Hæmatite, Swift River, St. George's.
Hæmatite (micaceous), Swift River, St. George's.
Iron ore, Woodstock, St. George's.

Copper Ores.

Native copper and cuprite, Providence, Port Antonio.
Copper glance, Rio Grande Mines, Portland.
Purple copper ore, Rio Grande Mines, Portland.
Purple copper ore, Hope Mine, St. Andrew's.
Purple copper ore and copper pyrites, Rose Hill, Portland.
Copper pyrites, Sue River, Metcalfe.
Copper pyrites, Brighton, Portland.
Copper pyrites, Orange Brook, St. John's.

Copper pyrites, Charing Cross Mine, Clarendon.
Copper pyrites, Ellerslie and Bardowie.
Copper pyrites and hæmatite, Swift River, St. George's.

Lead Ores.

Galena, Ugly River, Metcalfe.
Galena, Hope Mine, St. Andrew's.

Zinc Ores.

Zinc blende and galena, Hope Mine, St. Andrew's.
Zinc blende, Hope Mine, St. Andrew's.

Cobalt.

Cobalt, Blocksburg, Port Royal Mountain.

Manganese.

Peroxide of manganese, Guava River, Portland.
Binoxide of manganese, Marshall's Hall, Portland.

There are also—

Large Specimens of Mineral Veins.

Vein of copper glance in porphyry, Chesterfield, Portland.
Vein of copper glance in porphyry, Rose Hill, Portland.
Vein of purple copper ore in limestone, Brighton, Portland.
Vein of copper pyrites in porphyry, Black River, Portland.
Block of porphyry containing copper glance, Rio Grande Mine, Portland.
Vein of purple copper in shales, Rose Hill, Portland.
Vein of copper glance in porphyry, Brookdale, Portland.

and some others.

The earthy minerals are also a very interesting collection, and many of them will probably become exceedingly useful in the arts.

The collection from Jamaica includes a very fair representation of the island products, especially its main staples, sugar and rum. The minor products, however, have not been overlooked; and there is a fine collection of its useful and ornamental woods, numbering more than two hundred and fifty varieties. A very beautiful illustrative collection of fibres, well prepared, and scientifically named by Mr. Nathl. Wilson, the colonial botanist, is sent, which has been justly rewarded with a medal. Some new products of secondary importance are likely to be brought into use. Thus the outer cuticle of the Spanish dagger (*yucca orloifolia*) is shown by Mrs. James Nash to be admirably adapted for artificial flowers, and the Jurors have awarded her a medal for her skilful production and adaptation. Hitherto rice paper has been chiefly used, but this is brittle. Mr. Adcort has already ordered a large quantity of this material, to bring it into use in Paris and London. The ornamental nuts, seeds from the West Indies, and their applications to the purposes of personal decoration, are curious; but the subject is more collectively shown in a case exhibited by Mr. P. L. Simmonds, in the Eastern Annex. The other objects worth inspection in the Jamaica Court are the fruits, liqueurs (several of them new to Europe), preserves, a large collection of meals and starches, very many new oils, highly worth careful examination and experiment; the very fine cotton and drill made from it; the drawings of Jamaica scenery, and photographs of island fishes.

Cotton.—Three hundred and fifty years ago cotton was found in Jamaica, and we might still have obtained large quantities from thence, if the prohibitive duty on foreign sugar had not made the sugar-cane a more profitable cultivation. Since these duties have been removed from sugar, it has been supposed that the Americans could under-sell the free-labour cotton grower. The fact is, however, that the cost of slave-labour is at least double that of free-labour; and as the American war has greatly diminished the supply of cotton from that quarter, the price has been so enhanced, that its cultivation in Jamaica has again been entered upon, and will be found exceedingly profitable.

In all countries subject to frost the cotton is an annual plant. In Jamaica it is perennial, and in the parish of St. Elizabeth, trees are now bearing cotton which were planted forty years ago. It moreover bears two crops in the year.

Excellent drill and superior calico made from Jamaica cotton are shown by the Jamaica Cotton Company.

Jamaica sends a very satisfactory lot of samples of cotton, comprising New Orleans, Egyptian, Brazilian, and Sea Island varieties, all of good quality in their respective classes. The quantity now grown is small, probably not more than two hundred bales according to the most favourable report, but the quantity which can be grown is very great. The chief obstacle is the want of energy in the people. The accounts in this respect are very contradictory, for some authorities state that plenty of labour comes forward when steady employment offers. The Jamaica Cotton Company have an excellent prospect, if they can but secure the proper amount of labour. In addition to the company, two residents, Mr. Menal and Mr. Orgill, are entering extensively into cotton cultivation. The samples exhibited are as follows:—

No. 152.	Is an excellent sample of good growth cotton, worth	12*d.* to 13*d.*
563.	Reddish and overgrown, strong, worth	11½*d.*
564.	Strong and useful, worth	12*d.* to 13*d.*
565.	ditto	12*d.*
566.	Very weak, but white, worth	11*d.*
567.	Very strong, good cotton, worth	12½*d.* to 13*d.*
568.	From Egyptian seed, very like New Orleans cotton, worth	12*d.*
569.	Egyptian; has deteriorated, worth	12½*d.*
570.	A very good sample, worth	12½*d.* to 13*d.*
579.	Sea Island, not best quality, worth	24*d.* to 36*d.*
580.	Long, but very weak Sea Island	
581.	Good Egyptian, worth	16*d.* to 18*d.*
584.	Very good New Orleans (green seed), worth	13*d.* to 14*d.*
1321.	Kidney seed, strong and coarse, worth	13*d.*
1323.	Long Sea Island, worth	24*d.* to 36*d.*
1322.	Sea Island, short, but very good cotton, worth	18*d.*
1324.	Good useful New Orleans, worth	12½*d.*
1326.	Good cotton, very badly ginned, worth	12*d.*
1329.	Sea Island, very weak	
1330.	Reddish and coarse, very strong	13*d.*
1331.	Evidently mixed seed of Sea Island (black) and New Orleans (green mossy); produce very irregular, but good qualities	—
1332.	Beautiful Sea Island cotton, but very tender; valued by the jurors at	42*d.*

ST. VINCENT.

SITUATION IN BUILDING.—*Eastern side of North-east Transept.*

Volcanic ash, used as a cement, exhibited by F. Anderson, of Kingston, is the only mineral product sent from this island.

St. Vincent shows a very small collection of articles; indeed the Island Committee seems scarcely to have thought it worth while to put in an appearance at all. There are samples of its arrowroot, a very important product, a few preserves, one or two trifling natural history specimens, and other trifling objects.

DOMINICA.

SITUATION IN BUILDING.—*West side of the North-east Transept.*

The only minerals sent are specimens of the volcanic rocks of Dominica, and sulphur.

This island has also sent a very varied and interesting collection of its products, contributed by the Colonial Government, but for which the exhibition is chiefly indebted to the skill and assiduity of Dr. John Imray, the chairman of the local commission. These comprise, besides, specimens of building-stones and pottery, sulphur, fibres, and rope and twine made from them; bamboo fish-pots, bird-cages, and very neat nests of baskets; various nuts and seeds, and ornaments made therefrom; sticks, pickles and preserves, gums and resins, cocoa, coffee, sugar, spices, starches, barks for tanning, cottons, honey and wax, tortoiseshell manufactures, and specimens of natural history, with a large and interesting collection of specimens of native woods polished, numbering about one hundred and seventy.

For this collection a medal was awarded to Dr. Imray, and the island also receives a medal for a collection of various well-prepared starches. Some specimens of natural history shown (fishes, reptiles, &c.) ought not to be omitted.

BERMUDA.

SITUATION IN BUILDING.—*Eastern side of the North-east Transept.*

The minerals contributed consist of pumice-stone, coral limestone, two samples of lime made from coral limestone, two specimens of coral limestone polished, a large slab of stalactitic limestone, specimens of crystallized calcspar, and ornaments made from stalactitic limestone.

The collection sent from this island, although not very extensive, is varied and interesting. It includes samples of cotton (*G. herbacum*), gathered from trees nearly a quarter of a century old; furniture made of the Virginian juniper, called red cedar, which exhibits the peculiar grain of the wood; cedar berries, and jam and alcohol made from them; honey and wax; meals and starches from the arrowroot (which is the best in the world), the sweet potato, the cassava, and the plantain; castor-oil, and models of the Bermuda boats and yachts; rope and fibres from the palmetto leaf, plantain, American aloe, and changeable rose; palmetto work, from the leaves of the *Chamaerops glabia* and *excelsa*, both of which grow wild here in any soil, but to the greatest perfection in the marshes. Articles made of this leaf, such as hats and bonnets, dinner mats, common and market baskets, fans, card baskets, cigar cases, vases, &c., &c., can be procured in large quantities in Bermuda.

There is a good collection of the island woods, contributed by Dr. Henry T. Hinoon.

There are three samples of cotton sent.

No. 1.	Very good, white and strong, worth -	18*d*. per lb.
2.	Like Middling Orleans, worth - -	12*d*. to 14*d* "
3.	Short and white, worth - - -	10*d*. to 11*d*. "

The cotton plant is a perennial in the Bermudas, enduring for a period of from twelve to twenty years, grows to a height of eight or ten feet, producing abundantly during the whole term of its existence, and bears two crops a year. One of the above-named samples is from a tree about fifteen years old, growing wild in a barren spot; but if the plant was cultivated with the care that is bestowed upon it in the Southern States of America, abundant crops of the long stapled variety could be grown here, possessing all the silky fineness so desirable in the fibre. Both climate and soil are admirably suited for its production, and there is now land enough lying wild and useless that, if cultivated, would yield a million of pounds annually.

BAHAMAS.

SITUATION IN BUILDING.—*North Courts, west side of North-east Transept.*

A very pretty and varied collection has been sent by the Government of the Bahamas, which is well arranged and labelled. It comprises various kinds of fibres and ropes, also forest pine, palmetto hammock, and fair samples of cotton, which is indigenous to these islands, this having been the origin of the various Sea Island cottons of the Southern States.

These islands are noted for their sponge fisheries, and although the quality of the sponge is inferior to the fine Turkey of commerce, it is still of a useful character; and magnificent specimens of velvet, glove, and other sponges are shown.

Tortoise-shell is another staple product from hence, and large shells of the hawk's-bill and green turtle are exhibited. The shells fished up about the bays and shores are much in demand, especially helmet and queen conch shells, for cameos, of which beautiful specimens are shown. The sun shell, species of Cyprea, rice, and other shells are also sent; and some of the ornamental articles of shells are very pretty, in the shape of head-wreaths, baskets, flowers, &c. There are some exceedingly large pink pearls exhibited, obtained from the *Strombus gigas*. Bracelets and bags, made of the seed of what is called locally "jumbie beans," but which are the seeds of *Desmanthus virgatus*, a species of mimosa. The other products worth notice here are tobacco, cassava and arrowroot starch, cascarilla, and several other barks, a fine collection of woods, and large cakes of the wax obtained by boiling the fruit of the myrtle-berry, a species of *Myrica*.

The samples of cotton are, with one exception, very satisfactory; they are shown by Messrs. Harris and Co., of Nassau.

No. 1.	**Beautiful, equal to Fair Orleans, value**	- -	**13*d*. to 15*d*.**
2.	**Coarse, weak, and red**	„ - -	**8*d*. to 9*d*.**
3.	**Reddish; strong fibre**	„ - -	**11*d*. to 12*d*.**
4.	**Good, white, and like New Orleans**	„ - -	**12*d*. to 13*d*.**
5.	**From Exuma Bay, short, weak, and red**	„ - -	**under 8*d*.**
6.	**Beautiful long white fibre**	„ - -	**16*d*. to 18*d*.**
7.	**Black-seed variety, coarse, reddish, and strong**	„ - -	**9*d*. to 10*d*.**

The cultivation of the above ought to be encouraged, the samples being of a useful character.

As cotton was formerly produced in considerable quantities, its cultivation will probably be revived, and 100 bales may be looked for next year.

EAST INDIAN GROUP.

India.

Number of Exhibitors, 532.

Situation in Building.—*In the Gallery on the eastern side, and to the north end of the North-eastern Transept.*

The Surveyor-General of India contributes to this large collection some admirably executed maps of the Himalaya. These are executed by the Topographical Survey, which is now in progress. A map of this character forms the basis upon which to found any examination of a country. Professor Oldham is an exhibitor of a no less elaborate work, on which he is, with a staff of officers, now engaged. This is a Geological Survey of India. The maps shown are admirably executed. Professor Oldham is also an exhibitor of a series of coals, with their analyses, from the several Indian coal fields. In connection with these interesting specimens, the following information, given by the exhibitor, cannot but be interesting:—

The total returns give an average out-turn of coal for the past three years of 8,737,454 maunds, or 320,631 tons. But it is scarcely just to consider this as giving a fair mean of the present out-turn, for during the first of these years there were, as is well known, disturbing causes at work tending to injure the regular trade of the country—and a fairer average, though determined by too small a number of years, will be obtained by taking the mean of the last two years' produce. This will give 10,025,020 maunds, or about 367,890 tons in the twelve months.

The returns also show one important and interesting fact, namely, that however the local out-turn may have increased or diminished, as affected by local causes, the general out-turn has steadily and markedly increased, apparently indicating a healthy and sound extension of trade and commerce.

The total out-turn for 1860 (that is, for the twelve months ending October, 1860), was 10,088,113 maunds, or 370,206 tons, an amount almost contemptible (about the 200th part) if compared with the wondrous total of the coals raised annually in Great Britain, but still evidencing a large and increasing commerce and the spread of many of the arts of civilization.

The following is an abstract of the returns of coal raised from the Raniganj Coal-Field:—

	Number of Collieries.	1858.	1859.	1860.
		Tons.	Tons.	Tons.
Mines in the Singáran Valley – – –	11	32,220	86,994	80,792
Ditto, neighbourhood of Ràniganj – –	10	131,119	172,697	171,261
Ditto, Núnia Valley, Eastern Division –	13	17,064	21,284	17,348
Ditto, ditto, Western Division – – –	5	9,908	11,743	10,642
Ditto, West of the Field and others –	10	26,825	32,036	34,051
Total – –	49	217,136	324,754	304,094

The returns from the Rajmahal Hills, and the other coal-producing districts of India, in the same periods, give the following totals:—

Districts.	1858.	1859.	1860.
Ràniganj Coal Field –	5,917,000	8,949,600	8,559,097
Rajmahal Hills – –	219,000	843,000	1,222,860
Kurhurbari – – –	4,000	108.182	275,256
Palamow – – –	..	28,648	30,900
Sylhet Hills – – –	22,319	32,498	..
Total in Maunds –	6,162,319	9,961,928	10,088,113
Or in Tons – –	226,140	365,575	370,206

Dr. Watson, to whom the charge and the arrangement of the Indian collection has been committed, is himself an exhibitor of fifty-four samples of soils, including types of all the principal soils of India, to which is added the valuable information afforded by careful chemical analyses.

The East India Company exhibit a very good collection, illustrative of the manufacture of iron. The information afforded by this collection, as showing the iron-producing power of India, has led the Jury of Class I. to award a medal to it.

There are three or four exhibitors of tin ore from Singapore. This metal exists in considerable quantities in the southern peninsula of India, and in the islands of the Indian Archipelago. In 1860 we received from British India 1453 tons of tin, and from Singapore 830 tons. We also received from the same localities, but coming to us through Holland, 516 tons. Amongst the other minerals sent from India we have antimony from Candahar, sulphide of lead from Beloochistan and Rangoon, and also from the latter place fine specimens of the red and yellow sulphides of arsenic. Graphite is exhibited by the Rajah of Vizianagarum from a new locality. Petroleum and naphtha are sent from Burmah and Assam.

Of the earthy minerals there is a large collection; amongst the more interesting are a well selected series of pottery-clays and their manufactured products which have been exhibited by Dr. Hunter.

Mr. Montgomery Martin exhibits a most instructive model illustrating the great Hydrographical basins of India. The exaggeration of vertical scale is somewhat more than is desirable, but the water-sheds of the country are shown in a very striking and satisfactory manner. The works in steatite from India are well known. The local committee at Calcutta have, however, sent a very interesting series of these soapstone ornaments; and Colonel Guthrie has contributed to the collection a splendid series of works of art in jade and rock crystal. The labour bestowed in carving upon those hard stones is almost incalculable.

Of chemical and medicinal substances, forming Class II., there is a tolerable collection.

The vegetable and animal products used in the arts are numerously exhibited.

There is a fine collection of Indian grains and pulses exhibited, accompanied by analyses made by Dr. J. Forbes Watson. There are many other exhibitors of grains, rices, spices, &c. Dr. Campbell, of Darjeeling, shows a large and fine collection of teas grown in different localities of India; whilst Dr. Macpherson exhibits first mandarin tea at 20s. per lb. from Malacca. There is also a good assortment of Indian tobacco, opium, betel nuts, hemp, and other varieties. Under Class IV., there is a very fine case of Asiatic silk-producing moths, with illustrations of their transformations, and samples of silk arranged and collected by Mr. F. Moore, of the Indian Museum. Wools, horns, tusks, wax, and animal oils deserve notice: and the collection of vegetable oils is very full and complete. Of woods there are numerous collections shown, amongst which are fifteen kinds used at the gun-carriage department, Madras; two hundred and forty-seven varieties from South Canara, Vizagapatam, Chingleput, Darjeeling, and Mysore, partly tested for strength, with details of results; one hundred from Assam, and forty-two from Rangoon; one hundred and two from the Straits settlements and Malay peninsula, and 1023 woods from various localities sent by the Bengal Committee. Amongst the collection of woods those from British Burmah are the most remarkable. They are all more or less useful, but the teak is superior to them all. The best teak forests in British Burmah are on the hills between the Sitang and Irrawaddy rivers, and in the Thoungyen valley; but even these forests are poor compared with the extensive tracts covered with teak-producing forests, to the north of the British boundary, especially on the feeders of the Sitang and Salween rivers, and some of the tributaries of the Meinam, or Bankok river. The trees also are, as a rule, much larger, and the shape of the stem more regular, in the forests of the Burmese Empire, the Siamese Kingdom, and the Karennee country. The tallest teak tree measured in Pegu was 106 feet high to the first branch. The strength and density of teak timber vary exceedingly, according to the locality where the tree is grown. The extremes observed in preliminary experiments were 40 and 50 lbs. per cubic foot, and 190 lbs. to 289 lbs. breaking weight. Teak, when young, grows very rapidly. The two stems sent were dug out in July 1858, at the Thinganenoung Nursery in the Attaran forests. The seed had been sown in March and April 1856. The plants, therefore, were two years and three months old. The largest seedlings had a girth of 13 inches, measured one foot from the ground, and of 8 inches, at 6 feet from the ground. They were 32 feet high, but this is an instance of uncommonly rapid growth. Trees ten years old have usually a girth of 18 inches, measured at 6 feet from the ground, with 22 years a girth of 3 feet is attained, but full-grown trees of 9 feet in girth, cannot be supposed to be less than 160 years old. The collection of fibres and textile manufactures is most varied and extensive. From Chingleput, Dr. Short sends a series of silk—cottons, mat-making materials, and fibres, and substances employed for mat-making. There are also good collections of fibres from Lucknow, Madras, Assam, &c. Dye-stuffs and tanning materials, in which India is so rich, are well exemplified. The collections of paper, of native materials, is one deserving of careful investigation. The furniture of rose-wood, ebony, carved sandal and black wood, and inlaid work, is very beautiful. There are one hundred and sixty-six samples of various kinds of cotton shown, grown from indigenous Sea Island, and other American, Egyptian, Bourbon, and Pernambuco seed, which have been reported on by Mr. W. Wanklyn for the Manchester Cotton Supply Association.

It must be evident to all that it is quite impossible to do anything approaching to justice to this division of the collection. Many volumes may be written on the vegetable products of this great country. If any attempt to exceed the brief sketch given were ventured upon, it would—unless greatly extended beyond the limits of this work—still be sadly imperfect; therefore it is deemed advisable to leave it as it now stands.

Every Class appears to have some representative: carts and palanquins, machines for cleaning cotton, weaving apparatus, models of machines and agricultural implements, may be named as one series.

Inlaid arms of great beauty, and complete chain armour is exhibited by His Highness the Rao of Kutch. Krises, spears, and arrows poisoned with the juice of the Upas tree, daggers and scabbards, show the characters of the native arms of India. Naval architecture is not without its illustrations; philosophical instruments, made by native workmen, are shown. Photographs of the different tribes of India are ethnologically of great interest. Musical instruments from Thibet, and gongs from Burmah, illustrate Class XVI.

Textile fabrics are well illustrated, especially by the set of eighteen books containing working specimens of all the principal textile manufactures of India. The cotton goods exhibited are of a very varied character, and collected from almost every part of India. The Dacca muslins have been long celebrated; of these the Indian Government send some beautiful examples. The Government of Mysore exhibit some fine cotton cloths, and the Calcutta Local Committee have a large display of cotton fabrics of every description.

Fibres and their manufactures are altogether well displayed in Class XIX.; the twine of the *Rhea* fibre, the jute cloth from Darjeeling, the rope of *Urtica tenacissima*, and those exhibited by the governments, consisting of aloe fibre, hemp, coir, &c., deserve much attention.

The Class devoted to Indian silk is deservedly admired: there is a numerous collection of these beautiful fabrics, showing great delicacy in manufacture, considerable beauty of colour; and the embroidered specimens show that fine perception of colour in their harmonious relations, which distinguishingly mark the needlework of the Asiatics. The embroidered muslins from Scinde, Kutch, Tinnevelley, Benares, Lahore, &c., are beautiful.

The carpets and mats, which are in considerable variety, will command much attention.

On the stairs ascending from the Dais of the Eastern Dome to the Gallery, will be found two splendid specimens of the Bengal tiger, shot by Colonel C. Reid. Belonging to this Class we find red bulbul feathers, peacock-feather fans, and a considerable collection of feather manufactures from Calcutta.

The Class devoted to leather and saddlery contains but little of importance. The clothing is curious, and the display tolerably extensive. In the Paper, Stationery, and Printing Class we have the bark used by the former kings of Assam to write upon. There is a Thibetan work, in twelve volumes, with printing-blocks in the Thibetan character. Colonel Ramsay exhibits some fine Nepaul paper: and the Government of India contribute a series of papers made from fibres of different descriptions.

The carved furniture in sandal wood and ebony is singularly beautiful. There are a great variety of articles with inlaid work.

Lac ware, horn work, and papier-mâché made into jewel-boxes, dressing-cases, &c., are largely exhibited.

The Iron and Hardware Class contains some brass and copper vessels, as used by the natives, and a few manufactures in iron. The knives, daggers, and other steel manufactures from Burmah, Bangalore, Bokhara, Cuttack, and Salem, show the peculiar, and, in many respects, fine character of the Asiatic steel.

India has ever been the land of gems and of manufactures for personal ornament. Gold and silver ornaments, bangles, and bracelets, will be found of great elegance in the present collection. Pearls, emeralds, topazes, rubies, and diamonds are displayed. Much of the gold and silver filigree-work is delicately beautiful. Indeed, this Class excites the admiration of a large number of the visitors.

The ceramic manufactures do not require any special notice.

The miscellaneous Classes, containing ivory chessmen, back-scratchers, fans, children's toys, turnery-ware, models of temples, native paintings on ivory, pith-work figures, books and engravings, should be examined with care, since on every side are objects of curious and rare interest.

India, as represented in the Gallery of the Exhibition building, shows a country gifted by nature with every product which can minister to the use of man, or his luxuries. The whole has been most judiciously arranged by Dr. Forbes Watson, who has been himself a large contributor.

HONG KONG.

SITUATION IN BUILDING.—*It shares a portion of the space devoted to China.*

The collection transmitted by the colonial committee of this distant eastern possession of the Crown, comprises exclusively Chinese produce and manufactures. There are some rare and curious articles, especially collections of papers, with the wholesale prices. Chinese drugs from Hankon, in the interior of China, Chinese types and books, jade ornaments, the Emperor's seal, some ivory carvings, and such like; and a few articles from the island of Formosa, especially the pith and cellular tissue of the plant now known to yield the rice paper of China.

CEYLON.

Number of Exhibitors, 41.

SITUATION IN BUILDING.—*East side of the North-east Transept, under the Gallery.*

Amongst the minerals exhibited, the most important is plumbago. Of this substance very large quantities are now sent to this country, and much of it is of a quality sufficiently good for the manufacture of pencils.

There are a few iron ores, and some iron made from them.

The Ceylon products, although not so numerous as might have been anticipated from this beautiful island, with its rich vegetation and native enterprise, are nevertheless curious and attractive. First we have illustrations of its numerous valuable woods in a collection of one hundred and sixty specimens; then fine illustrations, in plants and logs, of its choicest furniture woods, satin-wood, ebony, tamarind, calamander, and jack-wood. The carved furniture, tables, Davenports, chairs, and footstools, are very elegant. A table of cocoa-nut wood, with illustrations of the numerous products of this noble palm, is very instructive. Here are gathered together the sweet sap converted into syrup, coarse sugar, or jaggery, spirit distilled from it, vinegar, and oil from the nut; the shell of the nut, beautifully carved and mounted, as a drinking goblet, and in slices as spoons and ladles; the fibrous husk of the nut macerated for spinning into yarn, and rope, and matting, and a dozen other exemplified uses of the trunk, leaves, &c.

The splendid bales of cinnamon, the culture and preparation of which is confined to this island, next deserve notice. There are some interesting photographs of the particular caste of natives, who carry on the operation of peeling the bark, and all the implements used in the operation.

The collection of fibres is interesting, and many of these, at present little known, have attracted much attention. The various mats and baskets are curious, and the dyes and staining substances are deserving of more attention than has hitherto been given to them.

Dyeing lichens, especially *Rocella tinctoria*, have been recently turned to account in Ceylon.

The food substances, spices, &c., form an interesting feature, such as the coriander, pepper, vanilla, nutmeg, &c., and tapioca, arrowroot, cassava, rice, and grains.

Of the staple product of this island—coffee—there are some magnificent specimens. There are some pretty ivory and tortoiseshell ornaments, and a few specimens of natural history. The oils, gums, and waxes are many of them new to commerce; and there are some fine collections of medicinal substances which deserve the close attention of the pharmaceutical chemist.

The models of the native boats in use, a gilt model of the shrine in the temple of Kandy, in which the sacred tooth of Buddha is deposited, and an agronomical map of Ceylon, by the Surveyor-General, are the chief other articles worth particularizing. The latter shows, in coloured patches, the seats of production of all the principal articles, cocoa-nuts, rice, coffee, cinnamon, &c. One other object may be mentioned, the different stages of growth of the pearl oyster, the shores of Ceylon being now the seat of a prolific pearl fishery which yields every five years a large revenue to the government.

Ceylon sends three samples of cotton:

No. 1.	Like good strong New Orleans, worth - -	12*d.* to 13*d.*
2.	Like low Middlings; not good colour, but strong, worth - - - - - -	12*d.*
3.	Short, weak, and coarse, worth - - -	10*d.* to 11*d.*

The quantity of cotton grown in Ceylon is nominal. It was formerly produced in large quantities, and it is very probable that the cultivation will be revived, if prices maintain anything like the present standard. The quantity actually sold of native Ceylon cotton is so small that no fixed price can be named as to its market value.

The government of Ceylon is giving every encouragement to cotton cultivation, by very liberal grants of land; and in this it is actively supported by the Colonial Secretary, the Duke of Newcastle.

The reports of the Cotton Supply Association on Ceylon cotton have had a very good effect in attracting public attention, and stimulating to an increased production, and, by the aid of Chinese labour, the cultivation will most probably thrive.

MAURITIUS.

Number of Exhibitors, 25.

SITUATION IN BUILDING.—*North Courts, near the entrance to the Horticultural Gardens.*

Mauritius shows a very fine, although small collection. The specimens of sugar, for which the colony bears a high character, both for quantity and quality of production, are exceedingly good, and have been appreciated by the jurors, as is indicated by the number of medals awarded. There were nine exhibitors: Messrs. C. Wiehe and Co., E. Icery and Co., H. Barlow, R. Bullen, Belzim and Harel, Messrs. Guthrie, J. Currie, Stein and Co., and F. Breard. The peculiarities of the Mauritius sugars are the different qualities made for export and consumption in the Cape and Australian markets, as compared with that manufactured for the British market, to suit the differential duties. Nearly all the exhibitors show the marked difference between the unrefined and refined sugar, and the inferior sugar made to meet the English standard duty of 13*s.* 10*d.* the hundredweight.

There is a well-arranged collection of 54 fibres, prepared at the Botanical Gardens, Pamplemousses, by Mr. J. Duncan, the director, from plants and weeds growing on the spot. Among these are many of the *sidas*, *agaves*, and *yuccas*, *hibiscus*, *sanseviera*, and *dracæna*. The arrow-root, prepared from tubers grown in the gardens, nutmegs, mace, and cloves, are excellent.

The tobacco products shown by Messrs. Bergicourt, Hard, and Co., comprise a dozen bottles of snuff, seven boxes of cigars, made from Coringhy and American tobacco, and one box of cigars, made of Faham leaf (*Angrecum fragrans*).

There are 25 specimens of woods shown by Mr. W.

Murphy, all scientifically named, and their characteristics and uses given. The principal of these are the Bois de Natte, a tall and large tree used for house and ship building, and cabinet work, *Tacamahaca*, and Malabar wood.

Canelle wood, which makes pretty furniture, one or two species of ebony, camphor wood, used to make boxes for the preservation of woollen cloths from insects.

The various uses to which the vacoa tree (*Pandanus utilis*) are turned, is shown in the roots split for cord, to fasten thatch, made into a whitewash brush, into bags for packing sugar for shipment, mats for bedding, hats, and baskets. Hats are also shown, made from the leaves of the date tree, and with the grass called locally *herbe de Caen*; baskets and fans, made from the leaves of the double cocoa-nut (*Lodoicea Sechellarum*), and baskets from Seychelle grass.

AFRICAN COLONIES.

NATAL.

SITUATION IN BUILDING.—*Northern Courts, on the western side of North-east Transept.*

One of the most picturesque and romantic Courts of the Exhibition is certainly that of Natal. Here we have all the elements of savage and civilised life combined, and great taste has been displayed in the arrangement of the objects. The pictures, ornaments, weapons, and other utensils of the Zulus, Kaffirs, and of the natives, command immediate attention, whilst the rich spoils of the chase show the abundance of wild animals to be met with by the sportsman. Here are ranged the feathers of the ostrich, tusks of the elephant, fine skins of various wild animals, skulls and horns of the gnu, the antelope tribe, the rhinoceros and hippopotamus, dressed leather, snake skins, karosses, or rugs of the skins of different wild animals. A large collection of most interesting objects of natural history—insects, reptiles, land shells, &c. Combined with these, however, are objects more characteristic of the settled pursuits of industry: tea, coffee, sugar, arrowroot, cotton, maize, wool, preserved and bottled fruits, exotic and indigenous; fine collections of woods, vegetables, fibres, and other articles.

This collection is one that the visitor may linger over, and inspect with interest and advantage, for never has a similar collection of South African products been brought together, so well arranged and named.

A favourable set of six samples of cotton are shown; they are all of good quality, well prepared, and worth 12*d*. to 14*d*. per lb. If the trifle above 5*d*. per lb., at which it was sold, was considered remunerative, there can be little doubt but that the cultivation will extend, for the quality is all that we require.

The cotton-plant grows readily in Natal. During the year 1861 nearly two thousand pounds weight of cotton, worth 43*l*. sterling, was exported from the colony, as the first fruits of a series of small experiments. The six samples (numbered 201) are specimens of this produce. The main difficulty for the present in the way of success seems to be the readiness with which white colonists find more productive applications of their energies, and the unwillingness with which the Kaffir enters upon any system of work that ties him to the performance of a certain task at a certain time. The colonial government is at the present time making an attempt to encourage the Kaffirs to grow cotton. It would be premature to say much as yet of the prospects of this experiment, but the sample 201 is a portion of its result. This cotton was both grown and ginned by the natives.

The mineral collection is small. Plumbago and galena, with a few building-stones, being all that is exhibited. The topographical map of the colony by Dr. Sutherland is a valuable production, and the charts by Dr. Mann, illustrating the climate of Natal, are instructive.

CAPE OF GOOD HOPE.

SITUATION IN BUILDING.—*Northern Courts, near the west side of North-east Transept.*

Adjoining the Bahamas Court, to the north, is a fine collection of South African fibres, exhibited by Mr. T. G. Ghislin, which is the only representation of Cape products. Mr. Ghislin also shows a case of most interesting applications of seaweed, under the name of laminate horn, produced from the *Ecklonia buccinalis*, and its allies, by chemical agency, and rendered applicable to purposes of manufacture and commerce, as is shown by whip handles, parasol and umbrella handles, knife handles, picture frames, &c., made of it.

ST. HELENA.

SITUATION IN BUILDING.—*Near the entrance to the Horticultural Gardens, close to the Mauritius and China.*

This island sends a small collection, comprising samples of the woods grown on the island, building-stones, coffee, birds, fibres, &c.

St. Helena also contributes three samples of cotton, grown by Mr. Baker—

No. 1.	Very dusty and ill-prepared, naturally a good cotton, and, if properly picked and cleaned, would be worth - - - - - -	12*d*. to 13*d*.
2.	Strong, serviceable cotton; good colour - -	12*d*. to 13*d*.
3.	Not a good colour, reddish, apparently overgrown, but a strong useful cotton - -	10*d*. to 11*d*.

MEDITERRANEAN COLONIES.

MALTA.

SITUATION IN BUILDING.—*East side of North-east Transept, under Gallery.*

The Malta Court is chiefly distinguished for its beautiful specimens of lace and silver filigree and coral work, which are especially attractive to ladies. The carvings in Maltese stone, and the marble mosaic tables, should also be noticed.

There is a good collection of agricultural products and specimens. The soup pastes of Simola, or the gluten of the hard wheat peculiar to Sicily and Northern Africa, form an important manufacture. The cottons and cotton fabrics, and other industrial products, show Maltese enterprise.

There are of the cotton samples—

No. 1.	**Very white, good staple, shorter than American; very well cleaned**	**10½*d*. to 11*d*.**
2.	**Very white, weak and irregular**	**9½*d*. to 10*d*.**

' The ordinary price in Malta is about 7*d*. per lb., or perhaps lower; of course it is now as in other countries, higher. A very great increase has already commenced: one crop has been harvested, and in August, another will be coming forward. Cotton is being grown everywhere in the Island, and also in Gozo. The late governor, Sir W. Reed, tried to introduce the American seed, but the natives would not have it because the plants occupied the land longer than the native variety. Labour is cheap, 10*d*. to 15*d*. per day, and abundant, and the commissioner reports that there is great excitement about cotton growing, and a very strong inclination exists to grow it.

IONIAN ISLANDS.

Number of Exhibitors. — Cephalonia, Cerigo, Corfu, Ithaca, Paxo, Santo Maura, and Zante, 177.

SITUATION IN BUILDING.—***North Courts, near the Central Avenue, and entrance to the Horticultural Gardens.***

These islands, although not coming under the category of colonial possessions, yet being under the protectorate of the British Crown, must properly be noticed here. The minerals of these islands appear to afford only lime and limestone, chalk, sand, a red ochrey earth, and some cements. The collection is principally attractive for its costumes, jewellery, and silk; its huge wax tapers for church use, embroidery, and other manufactures. The seven islands are all well represented. Wine, olive oil, and dried fruit are its staple products, and for these it has been duly rewarded. The inlaid works in native woods, agricultural products, flax, sponges, soap, &c., deserve mention. There are a few samples of cotton shown; their general character is very short and weak, but well cleaned. A good deal of cotton is grown and manufactured into various fabrics, of which there is a very interesting display. Mr. Drummond Wolff, the Ionian commissioner, is very anxious that the natives should be furnished with better seed. If they will prepare cotton of a good quality as carefully as they have done their own short-stapled, their produce will command a first-class position. The samples exhibited are from—

Zante, of a superior quality	worth	11*d.*
Corfu, No. 73--Very clean, but weak - -	,,	10*d.* to 10½d
St. Maura Clean, short, and weak - -	,,	8*d.* to 9*d.*
No. 135, from native seed, very short and weak, but good colour - - - -	,,	8*d.* to 9*d.*

There has been no survey of the islands, and it is impossible to estimate what could be grown.

CHANNEL ISLANDS.

SITUATION IN BUILDING.—*North Central Courts near the Staircase leading to Gallery from the Music Court.*

Exhibitors.—Jersey 5, Guernsey 2.

Artificial flowers, algæ, eau de cologne, photographs, and a model of dock gates, represent the industry of Jersey; while Guernsey has a good illustration of the chemical products obtained from sea-weeds, and a model of a paddle-wheel steamboat.

Foreign States.

It has been thought advisable to preserve the alphabetical order, which has been adopted in the Official Catalogue; especially as it will not be possible to give the names—they are so numerous—of the foreign exhibitors. The countries will, therefore, be found in the following order:—

- Africa, Central.
- Africa, Western.
- Belgium.
- Brazil.
- China.
- Costa Rica.
- Denmark.
- Ecuador.
- Egypt.
- France and its Colonies.
- Germany:—
  - Austria.
  - Zollverein States.
- Germany:—
  - Mecklenburg.
  - Hanse Towns:—
    - Bremen.
    - Hamburg.
    - Lübeck.
- Greece.
- Hayti.
- Italy.
- Japan.
- Liberia.
- Madagascar.
- The Netherlands.
- Norway.
- Peru.
- Portugal.
- Rome.
- Russia.
- Sandwich Islands.
- Siam.
- Spain.
- Sweden.
- Switzerland.
- Turkey.
- United States.
- Uruguay.
- Venezuela.

Situation in Building.—*On the Western side of the Central Avenue, both on the Ground Floor, and in the Galleries, with the exception of China and Japan, which are on the Eastern side of the Avenue, near the Horticultural Entrance.*

CENTRAL AFRICA.

Situation in Building.—*Under the Staircase, near the Central Entrance to the Horticultural Gardens.*

Dr. W. Balfour Blackie, R.N., exhibits a collection of native products, which are of considerable interest. There are a variety of cloths made by the natives, and used by them as clothing. Mats, hats, head-dresses, and sword-hangings. For these the description given in the Catalogue is sufficient.

WESTERN AFRICA.

Situation in Building.—*Near Central Africa.*

The Commercial Association of Abeokuta have collected and contributed oils and seeds, especially long black pepper, and some senna leaves, in illustration of the vegetable products.

Akase cotton is exhibited, and some other examples. Cotton is obtainable in any quantity, and is now grown extensively throughout the Yoruba country, especially to the east and north. Great quantities of cotton cloths, of a strong texture, are annually made, finding their way to the Brazils, and into the far interior. To obtain a largely increased supply of cotton, it is only necessary to open roads, and bring money to the market. Upwards of 2,000 bales have been exported this year, and the quantity would have been doubled or trebled if the country had been at peace. The present price is 4½*d.* per lb. The other fibres, many of which are exhibited, are not at present made for exportation, though, doubtless, some of them —jute, for instance—would be, if in demand. Of the native manufactures, the grass cloths, made from palm fibre, and the cotton cloths, are most prominent. Very nice leather work is done. The art of dyeing Morocco leather different colours has been introduced from the interior. Indigo is almost the only dye which can be obtained in considerable quantities. The natives manufacture all their own iron implements, and the quality of the metal is considered good.

The only mineral product exhibited is antimony, from Illorin. There is a collection, made by the late Dr. C. B. MacWilliam, from the confluence of the Niger and Tchadda; and Mr. R. B. Walker, of Gaboon, sends a collection of mats, fibres, and other commercial products, with the native arms and musical instruments of the Ba Fan tribe.

BELGIUM.

Number of Exhibitors, 862.

SITUATION IN BUILDING.—*The North-west Court, at the Western end of the Nave, on the Eastern side of the North-west Transept, and in the Gallery above.*

This country has long been celebrated for its production of iron and coal; of the latter valuable material Belgium produces annually about 8,295,000 tons, of 2,240 lbs.; of this a return, published by the Chamber of Commerce, at Mons, informs us that there was produced in that division of the Belgium coal-field, in 1859—

	Tons.
Couchant de Mons - -	2,968,784
Centre Occidental - -	542,970
Total - -	3,511,754

The produce has for some time preserved a steady advance. During the last ten years Belgium has sent into France 20,651,313 English tons of her coals.

M. E. Armand exhibits a collection of the hydrated oxides of iron, and his manufacture of charcoal iron from them, which was of that high quality to command a medal. Rolled sheet-iron is exhibited, of a very fine description, with very beautiful surface, by Delloye, Matthieu, Raikem, Verdbois, T. Remacle, and Perard. The Société des Laminoirs de Haut Pré are also exhibitors of the same class of manufacture. From the Forges of Providence some difficult pieces of wrought-iron are exhibited. The girder and forged wheel are especial examples of good workmanship. The Société des Forges et Laminoirs de l'Heure are also exhibitors of railway axles of excellent quality, and the good quality of their iron is shown in a cold twisted axle.

There are many other exhibitors of charcoal and other iron, the qualities generally being superior. The works of Belgium absorb nearly all the iron ore raised in the country. There existed in 1860 nearly 1200 explorations for iron in full activity, producing about 561,642 tons of the oxide of iron; of this there was exported about 35,000 tons to Flanders, Luxemburg, and the environs of Tournai.

The Société Anonyme du Bleyberg exhibit lead ores, lead and silver; lead is also sent by the societies of Corphalie, Nouvelle Montagne, of Rocheux, and of Oneux; and in the latter, lead is associated with lime and iron pyrites.

Under the direction of the Minister of Public Works, the rocks and the mineral products of Belgium have been collected; these have been classified and described by M. Jules Scherpenzeel Thim, in an admirable manner. Of the Geological series we cannot find room to speak.

The Calamine Works of the Vieille Montagne have a world-wide celebrity; their mines are the most important and the richest in the world. The larger quantity of calamine is worked open to day; the quantity extracted has been estimated at 340,000 cubic metres, which would represent about one million tons of calamine.

The mines of Bleyberg produce galena, blende, and iron pyrites. Those of Rochaux produce iron pyrites, more especially; in 1860, 18,000 tons of which were exported, principally to this country. Large quantities of the sulphur ores of Belgium are used in the chemical works of Newcastle in the production of oil of vitriol.

In the collection exhibited by the Nouvelle Montagne Company there is a remarkable specimen of cadmium.

In connection with mining, the Société Anonyme of Châtelineau have a well-executed plan and elevation of the apparatus employed at a large Belgium colliery for pumping, for raising the coal, and lifting the men by a *fahrkunst*.

N. Libotte and F. Nyst exhibit safety-cages and apparatus as applied to colliery shafts.

There are some exhibitors of whet and grinding-stones, some excellent quartzite paving stones, marbles of various descriptions, especially some very fine black marble from Basécles.

The chemical class is not particularly rich, nor does it appear to contain any product which has not been already described in Class II. of the English division. Brasseur has some good white lead, and ultramarine of very fine colour. The preparations from wood, exhibited by T. J. Bruneel and Co., are all of excellent quality. Cappellemans and Co. exhibit a considerable variety of salts, all of them being choice specimens of chemical manufactures. The white lead preparation of Delmotte-Hooreman are favourable examples of his manufactures. De Wyndt and Co. appear to have introduced into Belgium the manufacture of sulphur, and to have introduced many improvements in a sanitary point of view, in the apparatus employed in its production. Being an exhibitor a medal has been awarded him especially on this account. There are several exhibitors of animal black and bone dust, and of naphtha, photogen, lubricating, paraffin, and other oils, obtained from the Boxhead coals of Scotland. Leon Deltenre-Walker has exhibited a fine collection of varnishes, for use in the Fine Arts, photography, and in the Industrial Arts. The starches exhibited from Belgium are very pure.

There is a good display of hops from Belgium, the growth and sale of which are features of great importance to the country, and is chiefly carried on in the neighbourhood of Peperinghe. The Agricultural Association of Ypres, and the Agricultural Society of East Flanders, exhibit the best samples.

The rules with regard to the culture and sale of hops are very stringent. The Government seal is affixed to, and serves as a guarantee for, all good qualities, while such as are bad, or mixed, are liable to be destroyed by the authorities.

Tobacco is also extensively grown in the western provinces of Belgium, although large quantities are annually imported from the Havannah. The latter is manufactured chiefly at Antwerp; and we may mention A. Stein and Co., as showing the best cigars of this kind. The various Agricultural Societies also exhibit largely.

The manufacture of stearine candles, &c., which is of great importance, is finely illustrated in the Trophy exhibited in the Nave, by Messrs. de Roubaix, Jenar and Co. It may be mentioned as a proof of the importance of this branch of industry that the premises of this firm, lately consumed by fire, were insured for the large sum of 1,036,000 francs.

Messrs. Brugelman and Halstead, and Deneyer, illustrate a method for making artificial woollen goods, from old rags, mungo, shoddy, &c., and refuse from the looms.

Flax is much grown and extensively manufactured in Flanders. Messrs. Lefebure exhibit the produce of their factories.

Carriages are but little shown, the only exhibitor of note being J. De Ruyter, who shows a clarence, very elegantly designed and finished. The chief merit of his carriages is, however, cheapness.

Machinery, &c.—Belgium exhibits a six-wheeled goods engine, designed for burning coal, by the Couillet Iron Company; a first-class saloon railway carriage for summer travelling, in which the central compartment is replaced by a simple platform, enclosed by an open iron railing, and covered by a light roof. This carriage was made by the General Rolling Stock Company of Brussels, who also exhibit a series of wheels, tyres, axles, and other ironwork for railway carriages.

The principal Belgian ironworks contribute specimens of rails of different patterns in wrought iron and puddled steel, and tyres made without welding in steel and iron up to 6½ feet in diameter.

A railway weighing-machine is exhibited by Van Der Elst, and Co. of Braine le Comte.

Several large and important machines are exhibited; but they are principally of a nature unsuited for exhibition in motion in a temporary building on imperfect foundations. The largest group of objects is that contributed by Messrs. Cail, Halot and Co., consisting of a set of vacuum apparatus and other appliances for sugar refining, almost identical in construction with those exhibited on the French side by Messrs. J. F. Cail and Co. of Paris. In this case, however, the cane mill is replaced by the rasping or pulping machine and the hydraulic presses, which are employed in extracting the saccharine juice, in the manufacture of beet-root sugar.

Two complete machines for making paper are exhibited by Mr. H. D'Autrebande, and Messrs. Laroche and Co. They are placed parallel to each other on opposite sides of the central avenue of the Western Annex. The most striking object among the machinery in motion is a pair of blowing engines, having the steam and blowing cylinders placed horizontally. These engines, which are of 200 horse-power, are constructed by Mr. L. Perard on Fossey's patent principle, in which the apertures for the admission of the air into the blowing cylinders are very numerous, and are opened or closed by means of a rotating disc, worked by toothed gearing from the steam-engine, instead of using leather valves, to be opened and shut alternately by the pressure of the external air and the compression of the air in the cylinder.

Mr. G. Scribe exhibits a horizontal engine of 30 horse-power, on a modification of Woolfe's principle, which was first introduced in Cornwall by Mr. Sims. The cylinders are so arranged, that the two steam pistons are fixed on one rod, passing through the central line of both.

Various carding and other preparing machines, for the use of woollen manufactures, and machines for dressing and shearing woollen cloth, are exhibited by the members of the local committee for the district of Verviers.

A new method of transmitting a rotatory motion from one shaft to another, not lying in the same plane, without using toothed gearing, by the use of a curved spiral spring or flexible screw, is exhibited by Mr. Thirion, whose model shows the application of this plan to windmills.

Continuous crushing and jigging machines for dressing metallic ores, small coal, &c., are exhibited by Mr. E. Dumont and Messrs. Cail, Halot and Co.

Mr. Dehaynin's manufactory for preparing patent fuel by the compression of small coal or slack, is represented in a series of drawings. This class of machinery is now coming into general use in the colliery districts of Belgium and the North of France, as by its use a good class of fuel, which in many cases is of greater density than the original coal, is produced from the refuse of the workings, and as it is usual to remove the earthy matter from the slack, by washing before compressing it, the amount of ash is notably diminished.

Berard's coal-washing machine, which was exhibited in 1851, is well known. A medal has been awarded to him now, for the results which have been obtained, and for the extension of the principle to the washing and dressing metallic ores.

Amongst the articles employed in building will be found some handsome doors, exhibited in the Gallery belonging to Belgium. These are by J. Godfroy.

Especial attention should be given to an inlaid floor, of great beauty, which is shown in connection with these, the workmanship and finish of which are most complete.

J. Leclercq exhibits a handsome chimneypiece in white marble, in the Flemish style, with Caryatides. The design as well as workmanship are good.

To this Class belongs a pulpit carved in wood. It is placed under the Western Dome, and it must be regarded as one of the finest things in the Exhibition of its kind.

The display of fire-arms is very good, and is contributed chiefly by the cities of Liége and Brussels. The entire population of the former may be said to be dependent upon this manufacture for subsistence.

Of military small arms, Malherbe and Co. make the most complete display. This firm is one of the most important, and exhibits specimens of all descriptions of fire-arms made for exportation.

Among the more curious are a rifle in use among the Cossack troops, and a newly-invented revolver rifle. The Cossack wears his rifle slung at his back; and in the rifle here shown, the trigger and hammer have been modified, so as not to present sharp points, as is usually the case. The hammer is a smooth ring, for the insertion of the thumb, and the trigger is reduced to a round button. The revolver rifle is the invention of Count Al. De Bylandt. It has six steel chambers, in which the cartridges are placed, and one of which is inserted in the breech when the piece is used. After it is discharged this chamber is replaced in the cylinder and another takes its place in the breech. The mechanism by which this is effected is simple, and works with the greatest ease.

Samples of the guns supplied to the natives of Africa are shown by Jongen Brothers, and from their appearance it would seem as if these could not be very formidable antagonists. The barrels are nearly 5 feet long, and the stock (of the shape usually seen in the hands of the Arabs) is painted red, which would appear to be a *sine quâ non* of its sale. A highly-finished and elaborately-carved sporting rifle and brace of pistols are also shown, the former by M. De Lezaack the latter by M. Bernimolin, Brothers. A beautiful specimen of gun-stock carving, by an artist of the name of Tinlot, is shown by M. Dandozy. The collection of sporting arms from the various Liége ateliers is fine. An important feature in all these are the very low prices. F. Ladry contributes a machine for testing the accuracy of rifles, constructed to allow for the recoil of the piece, and to be levelled with perfect ease and freedom.

The "carabine multiple," invented by M. Fafchamps, is designed for the defence of forts, streets, and fixed posts. It consists of fifty rifled gun-barrels, which are loaded at the breech by means of a tray, in which the required number of cartridges are placed. The whole is upon a stand, which can be raised or lowered at the will of the man working it, who is concealed behind the stone-work. Aim is taken by means of two pieces of looking-glass; placed one above the other at an angle of 45°, and which, in case of damage, are easily replaced.

Duhent's military camp bedstead is mounted on wheels, and is designed to serve as a bed for two men, or a pontoon. The inventor also thinks it applicable to crossing rivers, and for this purpose he has provided it with an air chamber, to keep it floating.

Photography.—In this art Belgium makes a most important display.

E. Fierlants shows photographic reproductions of some of the masterpieces of the best Flemish artists such as—a head of the Virgin, by Q. Matsys, from the Museum of Antwerp; a portrait of Burgomaster Rokox and his wife, and a "Fragment of the Education of the Virgin," by Rubens, both from the Antwerp Museum. The "Casket of St. Ursula," by Hemling, from the Hospital of St. John, at Bruges. Hemling, as is well known, was a soldier, who, fighting in the wars of the Netherlands, towards the end of the fifteenth century, was received, wounded, in the hospital of St. John; and, from gratitude for the care bestowed upon him, painted several pictures at Bruges for the hospital; of these, the above is the most celebrated: another is the "Nativity."

A contemporary of Hemling's—Van Eyck—is also well represented; his "Virgin of Pala," from the Academy of Bruges, is well rendered, the brilliancy of his colours being evident even in the photograph. Many more by Rubens, Van Eyck, and Rembrandt, are shown in two very fine albums.

J. Michiels has reproduced modern pictures; while Ghémar Brothers exhibit portraits taken from life, among which that of the Count of Flanders deserves notice.

Music.—Belgium has always been celebrated for her musical instruments, and her display made in this Exhibition is very noteworthy, although the excellence of objects shown depends more upon the quality of tone than any new invention.

We may cite Ch. Mahillon, as exhibiting a complete collection of wind and brass instruments for military bands. The pianos of F. Jastrzebski are good.

As a curiosity, a violin that belonged to Charles IX. of France, repaired by Ch. Darche, deserves inspection.

The surgical instruments of Belgium are good, but they have not obtained the reputation of those made in France and England. There are only four exhibitors of these.

Textile Fabrics.—The Classes containing textile fabrics are well represented, although they will prove interesting chiefly to professional visitors.

The most numerous exhibitors in these Classes are the "Ateliers d'apprentissage," or apprentice' workshops, founded by the Belgian government, in consequence of a crisis in the linen trade of that country. Their object is to instruct the manufacturing population in the best methods for producing, and at the same time to supply them with more constant and regular employment. The apprentice enters after the age of twelve, and his wages vary according to the quantity of work performed. Manufacturers who wish to take advantage of an atelier, supply the raw material, and pay the wages of the workmen ; in case of competition, those having the preference who offer the most advantageous terms in point of wages, and whose work is calculated to further the objects of the institution, by exercising the workmen in the more advanced branches of the manufacture. A percentage of from 5 to 10 per cent. is set aside from the earnings of each apprentice, to buy tools, &c., upon his leaving the workshop. As by these means manufacturers have their work performed without the expense of overseers, and the usually large staff, they are enabled to compete successfully with the factories of other countries. Eighty of these workshops exist at present, supported partly by the government, partly by the provinces, and partly by the parishes for whose benefit they are erected.

The cotton goods from Ghent maintain their ancient reputation, although it is to be regretted that, owing to the new tariff, exhibitors have not come forward as well as might have been expected. Various articles, made from the refuse of old cotton, &c., from the weaving machines, are deserving of particular attention.

The firms of J. B. Jellie, of Alost, and the "Société Linière," of Ghent, are the best exhibitors of sewing threads.

The apprentice workshops have been enabled to compete successfully with the French silk and velvet factories, although in other countries the latter still have the preference.

The cloth weavers of Verviers have maintained their ancient reputation by a collective exhibition of great importance. Biolley and Son, Lahaye and Co., S. Simonis, and Lemaire, Duprès and Son, may be considered the most important exhibitors in this court. A. S. Deheselle sends a good collection of flannels.

The manufacture of carpets and tapestry at Ingleminster is important. This branch of trade had for a time diminished in Belgium, and was nearly extinct until revived by the Count of Montblain, Baron of Ingleminster. It is still in its infancy, and much trouble and money will have to be expended before it is brought to a state of efficiency, but excellent results have already been obtained.

Lace.—A most important feature of Belgian commerce is the lace manufactured in the country. The display made is quite deserving the fame acquired by ancient Flanders for this expensive article of toilette. The three principal kinds of Belgian lace are the Brussels, the Mechlin, and the Valenciennes. The Brussels lace is made entirely with a needle and thread, and then sewn on a ground of thin net. The people of Brussels assert that owing either to the influence of the air or the water, the thread used and made by them can be produced nowhere else. The Mechlin and Valenciennes are made with the cushion and bobbins, the latter of these chiefly in the huts of the peasantry. The Mechlin lace is made chiefly in long strips for trimmings.

The firm of Van der Smissen-Van den Bossche, of Alost, exhibit some application lace, which is equally remarkable for its beauty and cheapness. There are handkerchiefs costing from 9f. to 15f., some of which are of elaborate and most graceful design; the specimens of flounces are also remarkable for their very light and well studied patterns, but the gem of this case is a *pointe* or shawl of rich application lace, the design of which is the most elaborate and most perfectly composed in the entire display of Belgian laces, although it bears the moderate price of 3000f. To go to the other extreme as to costliness, Mr. Van Rossum exhibits two handkerchiefs of such minute and delicate workmanship that they have taken four years to complete, the thread used being No. 600. The price of one is 230*l.*, and of the other 240*l.* Madame de Clippele, of Brussels, sends a collar of mingled black and white lace, embroidered in the centre with the Royal arms of Belgium, and which is of great beauty and delicacy of texture. The most admirable designs to be found in the Belgian Court, however, are those of the black Grammont lace, shown by J. G. Lepage Kina, which for grace of line and the exquisite finish and happy combination of its details is worthy of the highest praise.

Leather.—Another branch of industry in which Belgium holds a high place is the manufacture of leather, the Flemish tanners having been famous from a remote period. The exhibitors are numerous, and their wares are for the most part of remarkable excellence. The manufacture of thin leathers, for the linings of hats, is a branch of trade specially cultivated by the Belgian leather-dressers. The firm of Hegh and Dugniolle distinguish themselves by their display of tinted moroccos for furniture, the quality and colours of which are equally good. The tanned skins from Buenos Ayres (unbeaten), exhibited by Prosper d'Ancré, of Louvain, are also deserving of mention for their excellent quality, as are the japanned cowskins for carriage heads and splash-boards, sent by L. J. Collet. In the same class are exhibited the oilcloths of Louis Jorez, one of which is of enormous dimensions, measuring 17 metres by 8 mètres, and quite as remarkable for the good taste of the pattern as for the closeness and flexibility of its texture. There are several exhibitors of belts for machinery and leather hose for engines, among whom it is only necessary to mention M. Eugène Van Schoonen, of Ghent, whose mode of joining the edges is with rivets in one case and seams in another, which lie even with the surface and do not occasion any additional friction. The hats for miners, made of solid leather, shown by J. Veniers, of Liége, are as remarkable for their power of resistance to any accidental blow as for their extreme cheapnesss, the cost of each being only two francs. The Belgian boot and shoe makers export largely to this country, and their excellent workmanship and material are so highly appreciated that it is almost needless to expatiate on them. Among the exhibitors in this Sub-Class, Van den Bos Poelman claims especial notice. His riding boots of unblacked leather are equally remarkable for their lightness, good shape, and glove-like suppleness: equal praise is due to the high water-proof boots for fishing or marsh shooting. A pair of thick-soled shooting lace-up boots are as solidly made and well finished, as they are astonishingly light.

The educational works of this country deserve attention, as there are some good contrivances for education of the deaf, dumb, and blind. It is impossible to enter more into the details, which would be of interest indeed, to but a limited number of visitors.

BRAZIL.

Number of Exhibitor, 230.

SITUATION IN BUILDING.—*On the Western side of the Central Avenue, between Turkey and Greece, near the Horticultural Entrance.*

In 1851, Brazil was represented by one exhibitor; on the present occasion there is not a more interesting Court in the Building than the small, but well-planned one which is devoted to the productions of the Brazilian Empire. Nearly every Class is represented. The collection of minerals is not large, but it speaks forcibly of the probability of the existence of extensive mineral formations. Nothing appears to be wanting but the enterprise and capital necessary for the exploration of such an extensive country. Little is known of the geology of this vast country: the maps—such as they are—inform us that the whole of the coast is of a granitic character, from its northern to near its southern extremity. This, however, includes evidently rocks of a very varied character, partaking more or less of the structure of igneous and metamorphic rocks. Consequently a survey by some practised geologist is necessary before the real value of the country can be determined.

Dr. Burlamauque contributes a collection of gold, diamonds, and other precious stones. The Brazilian gold-mines have been long known, several of them having been wrought by English companies. A considerable quantity of gold is obtained by washing the accumulated debris of the valleys, and much by actual mining upon the auriferous quartz lodes. The Brazilian diamonds have been long celebrated: occasionally, remarkably fine ones have been obtained. The Star of the South, exhibited in the Netherlands Court, is stated to be a Brazilian diamond. There are some very interesting diamonds, uncut, showing exactly the condition in which they are found in Nature, in the Brazilian Court; one of them, a cube, being a form which is by no means common. The formation of the diamond is one of the problems yet unsolved by science. Here is a crystal of intense hardness, which has been proved to be nothing but carbon, and consequently we may suppose of vegetable origin, found amongst the oldest of the Earth's formations. By electrical action, carbon has been rendered as hard as diamond-dust, but we have never yet approached to the production of a crystalline transparent body. M. M. Da Luz exhibits the diamond in its native gravel from Mines Geraes, and there is another specimen from the same district exhibited by M. S. Da Souza, and also one from Diamantina (See Vol. I., page 106, for further information on this gem). The emerald, of a fine character, showing its mode of occurrence, will be found amongst the gems (see Vol I. page 117): topazes, and some other precious stones are also exhibited, and there are agates and calcedonies of great beauty. Samples of coal from Brazil have been from time to time sent to this country: it has usually contained large quantities of iron pyrites, which has been objectionable. The Viscount Barbacena has sent some specimens of coal from Laguna in the province of Santa Catharina, which is of really good quality, and which must, if found in quantity, prove of great value. The specimens sent have certainly been taken from near the surface; there is little doubt but the quality would be found to be very superior if taken from the bed at some depth. Lignite is also exhibited from Ouro Preto, Minas Geraes. Several samples of iron ore have been sent to the Exhibition. The micaceous ore is very rich, as is also the magnetic iron ore; and the limonite, hydrated oxide, is of good quality. These ores have been analysed by an English chemist and metallurgist, who has reported favourably of their characters. Some iron castings obtained from some of these ores are exhibited: everything, in connection with the iron manufacture depends upon the quantity of material procurable upon the facility for obtaining the fuel and the flux required in the smelting operations. It appears, however probable, judging from the specimens exhibited, that iron of good quality may be made at moderate cost in Brazil.

The granitic rocks near the coast, and especially in the province of Rio Janeiro, are, to a considerable depth, in a state of decomposition, and from these are obtained the specimens of Kaolin (*porcelain clay*), and other clays exhibited; from this, some ware has been manufactured, showing that it is really available for the opening out of a very important industry. Copper and lead ores are exhibited, proving the existence of these minerals, but we are not furnished with any information as to the probable quantities in which they can be obtained.

The chemical and pharmaceutical products make a most respectable display, many of the chemicals being of a high character. The richest portion of the collection is that devoted to the vegetable products.

Woods.—The Baron de Maná and others send specimens of four hundred and ten varieties, many of them of great beauty. F. C. De A. Brusque exhibits a mosaic of the woods of the province of Para; and the Municipal Chamber of Desterro, a mosaic of the woods of Santa Catharina. These appear available for almost every purpose, and especially for cabinet work there is a great variety in colour and character.

Tea.—The specimens of tea exhibited are of a very fine character, all of them proving that the districts from which they have been sent—Minas Gerals, St. Paulo, and Parana—are important tea-producing districts. *Maté* in its native package is exhibited; this is the universal substitute in Brazil, especially in the southern provinces, for tea and coffee. It contains a nitrogenous alkaloid analogous to theine, and hence its general use.

Coffee is largely exhibited and of excellent quality; some good samples of chocolate accompany it.

Grains and Seeds.—Rice, maize, wheat, and beans are exhibited. There are two fine collections of beans, thirty varieties of Theresopolis beans from Rio Janeiro, and eleven varieties from the province of Ceará, which have excited much attention.

Tobacco and Snuff.—The tobacco and the cigars manufactured from the leaf are stated to be of the finest quality; the snuff is highly prized.

Starches.—Starch from various plants, arrowroot and tapioca, Jacatupé flour, &c., are exhibited.

Resins and Wax.—The collection of these vegetable products is large, and must be of considerable comm ercial value.

Sugars.—The crystallized and the refined sugar show that much attention has been paid to its manufacture.

Candles.—The Stearine Candle Company of Rio Janeiro are exhibitors of excellent candles, of glycerine and soap.

Fermented Drinks.—Rum, Hollands, various Brazilian wines, and liqueurs are exhibited; many of these are of excellent quality. Altogether, the vegetable products of the Brazilian empire must command attention.

Cotton and Silks, &c. are exhibited. The cotton is of long fibre, and possesses many of the best qualities necessary in this important article. The cocoons andraw and manufactured silk from the Province of San Pedro, speak well of this production. Altogether, the cotton and silk, especially the cotton counterpanes and the cotton piece goods, principally from the Province of Rio Janeiro, speak most satisfactorily of the textile industries of the people.

The aloe fibres, the cloth made from it, and embroidered, are interesting specimens.

The Brazilian leather has long been celebrated. The morocco and other leathers exhibited, the saddles, boots and shoes, maintain the high character of this manufacture.

The felt hats are of the most beautiful quality.

Amongst the manufactures of a general character, the engraved and ornamental glass holds the first class. There are three exhibitors, and it is not often that such close imitations of the Venetian manufacture have been seen. The gold lace,—the metal manufactures generally—there is but a small display—are examples of careful manipulation. The eyeglass made for the Emperor, and the Imperial arms in silver, are striking examples.

Amongst the miscellaneous series of interest must be named the case of flowers made of insects' wings, which is at th entrance of the court, and the vases of fish-scale and shell-flowers. The photographs of the Imperial family, and of the botanic gardens, are of interest, though they fail in perfect delineation, and in permanence.

The collection of ropes and fibre placed together, the hammocks suspended, the tanned skin of the red Socuryú snake, the feather flowers of the Imperial Mordomia, the examples of book-binding, of cabinet work, and the pictures, as representing Brazilian scenes, will be found of much interest.

CHINA.

Number of Exhibitors, 26.

SITUATION IN BUILDING.—*The North Courts, behind the Class devoted to Music, near the entrance to the Horticultural Gardens.*

There is nothing in the Chinese collection which requires any description. It is a collection of curiosities, having just that interest which must ever attach itself to such evidences of skill as are presented by the works of a strange people.

The carved mandarin jars, the carved screen and chessmen, are singularly beautiful, being rendered so by their minute work.

The Jade ornaments, especially the Emperor's seal and sceptre, the bronzes, and other similar matters, will be examined with curiosity; as will also, the autograph of the first rebel chief, and the human skull mounted in gold—foolishly "reported to be the skull of Confucius."

The Chinese drugs and pharmaceutical preparations are instructive.

COSTA RICA.

Exhibitors.—The Government of Costa Rica.

SITUATION IN BUILDING.—*Near the entrance to the Horticultural Gardens.*

The ores of gold, silver, copper, and lead, prove the existence of really productive mines in Costa Rica, of which we know but very little.

The sarsaparilla, and other vegetable products used in medicine, form a useful collection.

The country produces rice, coffee, cocoa, and tobacco of good quality—as these products, with some fruits, beans, &c., are exhibited.

The agave leaf-fibre, and some other fibres made into twine, the dye stuffs, several tanning agents, cotton, caoutchouc, nuts, and woods, show the value of the vegetable products; while the animal products are represented by tortoise and mother-of-pearl shells, tanned skins of the tapir, the otter, the jaguar, and the deer.

There are a few other articles, such as gold and silver filigree-work, cigar cases, calabashes, and cocoa-nut goblet.

DENMARK.

Number of Exhibitors, 299.

SITUATION IN BUILDING.—*North-west Court, with a front on the Nave. This Court extends to the walls of the Refreshment Rooms, and it occupies the Gallery above.*

Professor Forchammer has made an interesting exhibition of the minerals of Denmark and of her colonies. The South Greenland Mining Company exhibit tin, copper, lead, cryolite, and other minerals; while cryolite and its products are exhibited by T. Weber and Co. This natural production, from which aluminium is now economically prepared, has been used as the source for obtaining soda, and the process introduced, promises to make greater inroads upon the process of Le Blanc (See vol i. p. 101) than any discovery since 1797. The results exhibited are exceedingly instructive.

The chemical products, generally, are not of great importance. Some pigments, artificial manures, sulphuric acid, with the collection of chemicals contributed by A. Benzon, complete the series.

In the pharmaceutical preparations, there is little to notice beyond the oil of lemongrass (*Andropogon Citratum*), the artificial mineral waters, the hydrochloride of ammonia, and a few preparations exhibited by Stoltzenberg and Uffhausen.

The vegetable and animal products do not present anything requiring especial notice.

The machinery and tools consist of some weaving appliances, an apparatus for measuring and cutting cloth, some fire engines and agricultural implements, a camp kettle and appurtenances, some rifles from the Kronborg manufactory of arms, some models of ships, of a life-boat, and of whale and fishing boats, constitute the examples of military engineering and naval architecture. There is a machine worked by heated air, and some electro-telegraphic apparatus. There are photographs of course. The unfortunate facility given to the production of pictures by the Collodion process makes the repetition of mere photographs wearisome.

The display made by Denmark is an important one, when we consider the smallness of the country and its physical condition. It will be best to describe the objects belonging to the different classes exhibited, in groups, as some are but slightly represented.

In the Nave are two large stands, containing china from the Royal porcelain works at Copenhagen, and from the factories of Messrs. Gróndahl and Co.

The most prominent object in the collection of the Royal manufactory is a vase, presented by the King of Denmark to the Hanoverian ambassador. It is richly gilt and enamelled, and has, between the arms of Denmark and Hanover, the portrait of the king, and a view of an estate belonging to the ambassador.

The remainder of this Case contains specimens of earthenware cups, dishes, &c., in universal use in Denmark. They are white, with blue flowers.

The Case of Messrs. Bing and Gróndahl has a vase somewhat similar to that of the Royal manufactory, with a portrait of the king and a number of coats of arms round the neck. The chief attractions in this Case are, however, two tea-services of "egg-shell china;" that on the side facing the Danish Court is a copy from an ancient set in the Museum of Copenhagen, and the property of the Crown Prince; that on the side facing the

French Court is the design of Messrs. Bing and Gróndahl. The pattern is blue flowers on a gold ground.

Vidal's works in terra cotta, among which is a large vase, surmounted by a bunch of fruits and flowers, will attract particular attention.

With the furniture is an electro-plate copy of a font at Rome, the property of the Pope: it consists of illustrations from Scripture. The original is in silver.

The chief articles of furniture are a table and book-case, inlaid with tortoise-shell and metal, from the industrial school of Copenhagen.

The pianos are by Hornung, and Móller, and Petersen, and Sundahl—considered the best makers in Denmark.

After the specimens of terra cotta, a fine oak press will attract attention. It is about 12 feet high, and is finely carved, the four feet being supported by angels.

On the right-hand side, facing the entrance, is a case containing busts of the King and Queen of Denmark, in silver.

Behind this Case is a display of surgical instruments, some hats and boots, and some uniform jackets; these, however, are unimportant.

One of the most attractive things in this Court, perhaps, is a rug, made of the skins of seven white foxes (natives of Denmark). They are remarkable for the beauty and whiteness of the fur. This rug is exhibited by Trolle. Beside this there is a rug made of the so-called "blue foxes;" and a collection of skins and furs from Greenland.

A Case, containing articles of clothing, &c., from Greenland, exhibited by the Greenland Mining Company, will prove of some interest, especially the proofs afforded of Greenland drawing, in the shape of a Greenland newspaper (illustrated), and a picture-book, drawn and engraved by Greenlanders, at Gothhaab, South Greenland, giving some curious illustrations of the domestic condition of the Greenlanders, and some of their legends; amongst others, the story of the "History of Arigssiak, with the defeat and destruction of the old Scandinavians."

Some of the wood-carvings will be found of a high character. Much of the cork work, made by the prisoners, is curious.

The silver works, and the products in electro-plate, should be examined.

The drinking-horns, of the antique pattern, are remarkably fine, especially the horn executed by Schwartz and Son. It is carved of a natural bull's horn. The ornaments are in the old Scandinavian style. The four basso relievos represent the story of "Sigurth Fafnersbane and Brynhild," according to the Völsunga Saga, of Iceland. The first basso relievo is, "Sigurth slays Fafner the Dragon."

"When Sigurth, son of Sigmund, stroke
The dragon on the heath,
Hissing, the dying monster spoke
These words with fiery breath."

The second, "Sigurth pledging his faith to Brynhild."

"Blest be thou, maid of knowledge great,
Be thou my bride and norn!
And never I'll flee, though death may threat,
I'm not a coward born."

The third, "The ride of Sigurth through the flames to Brynhild."

"Who is riding o'er the furious fire
That around her bower flashes?
Earth quakes, and, tamed, the flaming ire
Sinks down and turns to ashes."

The fourth, "The revenge of Brynhild and death of Sigurth."

"For Brynhild's breast is full of harm—
Hot fire and chilling ice.
* * * * *
Her mind was hard, and wild her mood,
Her will was at last fulfilled,
In Sigurth's heart the spear's edge stood,
The king in his bed was killed."

In the Gallery will be found many examples of the educational appliances, books, &c., employed in Denmark, and a most excellent set of minutely-detailed contour maps, well suited to illustrate physical geography and geology; these are exhibited by the Royal Ordnance Survey.

ECUADOR.

SITUATION IN BUILDING.—*Near the Horticultural entrance.*

The walls of the Ecuador Court show a number of interesting oil paintings (executed by native artists), most of which are on religious subjects, and have been taken from the principal churches. Exceptions to these are, a portrait of General Bolivar, the eruption of Mount Cotopaxi in 1768, and the convent of St. Francisco, at Quito. Below these are cases containing samples of natural produce and industries. A curious production of this country is the ivory-plant, or "nigger's-head" tree. The fruit of this tree (the *Phytelephas macrocarpa*, one of the *Palmæ*) consists of several cells, each of which contains four seeds, the albumen of which forms a hard mass, very much resembling ivory in colour and hardness. This mass is manufactured into various ornaments, while the leaf of the tree is used by the natives as a covering for their huts.

Excellent cocoa is grown in Guayaquill; while the tobacco and cigars from Pailou and Esmeraldas, and the cotton from the affluents of the Amazon, deserve high praise.

Opposite these are a number of idols, discovered at the Port of Pailou, at a depth of seven feet below the level of the sea. The quillai bark (12) is used in South America for producing a lather, instead of soap, when washing woollens and silks. From the aloe fibre, or "pita" (16), obtained from the "*Agave Americana*," is made a fine white cordage, as well as paper. Silk, from the vicinity of Quito, is shown in small quantity; but of greater importance are the "Panama hats," some excellent samples of which are exhibited. These often fetch very high prices, and are a source of great pride to their owners.

Here is also shown some embroidery, made by the natives, which merits attention; but the most curious Case in the

Court is that in the centre, containing a number of gold ornaments and idols, discovered in tombs at Malletura, Pailou, and Chiriqui. The most extraordinary of the idols is the head of an Inca, a chief of the Fivaros tribe, which was worshipped in a temple near the River Pastassa. It was reduced to its present size by the removal of the skull and its contents, and the introduction of hot stones.

A sceptre of an Inca, and a necklace of gold and emeralds, of native make, are also curious.

EGYPT.

SITUATION IN BUILDING.—*North Central Gallery.*

The display made by Egypt is in many respects similar to that of Turkey. There are a quantity of embroidered stuffs made by the various native tribes, as well as matting of several descriptions. A series of photographs of the tribes inhabiting Nubia, Ethiopia, and the countries of the White Nile is interesting, also the earthenware from Siout and Assovan, and a collection of native weapons.

The gold and silver filigree-work made by the negroes of Soudan is highly interesting, and shows great skill and patience: there are two trays and a number of egg cups.

There is a large collection of saddles, the best of which are a Bedouin saddle of red morocco leather, a handsomely embroidered saddle for a general of division, and a dromedary saddle of green velvet richly embroidered with silver, the property of His Highness the Viceroy.

The greatest interest, however, attaches to a collection of antiquities from the New Museum of the Viceroy. The most important of these are a number of gold ornaments found on the mummy of a queen called Aah-hotess, who lived about the year 1800 B.C. They were discovered among the ruins of Thebes by Mr. Auguste Mariette. They were probably never worn during life, but are simply the ornaments of the dead. The first is a poniard with a gold blade, on which are engraved various subjects, indicating Asiatic tendencies; on the hilt is engraved the cartouch of King Amosis, son of Queen

Aah-hotess, and first of the 18th dynasty. A diadem has engraved upon it two sphinxes crouching on either side of a box. A golden hatchet (the symbol of divinity) has a representation of Amosis immolating a barbarian, on the blade. On a "pectoral" or brooch are figures representing Amosis between two divinities, pouring over him the water of purification. There is also a decoration, consisting of three large bees in solid gold. A gold chain, a yard in length, has a scarabæus, also in massive gold, suspended from the centre.

To this collection also belong a gold bracelet with figures in repoussé work, the subject of which is a religious representation, in which Amosis again occurs, and a massive gold boat on four wheels of bronze, with twelve rowers in silver, symbolical of the journey performed by the soul before reaching its last resting-place. On the poop is the cartouch of King Rames, husband of Queen Aah-hotess. These ornaments show no trace whatever of an enamel, the figures being placed on grounds of turquoise, cornelian, and lapis lazuli.

Two large ear-drops, having on one side the cartouch of King Rameses of the 20th dynasty, were found at Abydos, near the great temple discovered by Mr. Mariette.

FRANCE.

Class.	Number of Exhibitors.	Class.	Number of Exhibitors.	Class.	Number of Exhibitors.
I.	96	XIII.	58	XXV.	12
II.	193	XIV.	119	XXVI.	65
III.	125	XV.	58	XXVII.	168
IV.	1,997	XVI.	67	XXVIII.	141
V.	32	XVII.	59	XXIX.	177
VI.	13	XVIII.	62	XXX.	74
VII.	47	XIX.	25	XXXI.	164
VIII.	93	XX.	124	XXXII.	55
IX.	49	XXI.	200	XXXIII.	72
X.	45	XXII.	10	XXXIV.	37
XI.	41	XXIII.	54	XXXV.	38
XII.	16	XXIV.	69	XXXVI.	75

The French Colonies are—

	Number of Exhibitors.		Number of Exhibitors.
Guiana	28	St. Mary of Madagascar	1
St. Pierre and Miguelon	8	East Indies	22
		West Coast of Africa	7
Cochin China	1	Guadaloupe	34
New Caledonia	17	Isle of Reunion	87
Tahiti and Dependencies	11	Martinique	41
Mayotte and Nossi-Bé	5	Algeria	571

The above statement of the numbers of the exhibitors in the different Classes, and from the colonies, will show the important place occupied by France in this great International gathering. There are, however, but few things of great novelty, which have not been already noticed in the English division of the Handbook. From this it must be evident to all, that little more than a clear synoptical view of the products of this great country can now be given.

The mineral collection is by no means rich, still it is instructive as far as it goes. From the School of the Master Miners of Alais there is a mineralogical collection from the Department of the Gard. Oeschger, Mesdach, and Co., send ores and ingots of lead and copper from their smelting works at Biache Saint Vaast (Pas-de-Calais), founded in 1847. The Marquis of Chambrun contributes argentiferous galena, from Marvéjols (*Lozère*), and lead is also sent from Pongibaud (*Puy-de-Dome*). We have also specimens of this mineral from Bédoués and Cocurés; and the Mining Company of Pallières Alais (*Gard*) are contributors of sulphates of lead. From Corsica there are some copper ores; and a little antimony from the Puy-de-Dome. These are the chief examples of the metalliferous minerals, other than iron ore. The ironmasters of France have sent some good iron. Bonnor, Degrond, and Co., exhibit some iron wire rolled to a very fine gauge. De Deitrich and Co. have fine specimens of iron and steel, of difficult manufacture and good quality; while Durand and Guyonnet exhibit rod iron and wire of good quality, made from Oolitic ores. E. O. Martin is also an exhibitor of good iron.

Coal is exhibited by the Committee of the Loire, and agglomerated coal (patent fuel), and other derivatives from coal. E. Dormoy is an exhibitor of MS. maps, and a series of sections, showing in great detail the structure of the coal-field of Valenciennes and the adjoining part of Belgium; while M. Gruner has elaborate maps and sections of the coal-fields and subjacent rocks of the Upper Loire. There are indeed several works of a similar class, which have been rewarded by the International Juries for their excellence and completeness. These do not require enumeration; they will be found in the published Jury Awards.

The coal-fields of France are widely scattered, and are insufficient for the supply of the country. The production of coal, according to the official returns, is stated to have been in

1858 - - - -	8,400,000 tons
1859 - - - -	7,758,000 „
1860 - - - -	7,965,000 „

The quantity of coal sent into France from the English coal-fields, has been for some years past about 7,250,000 tons.

Amongst the metal manufactures, the products of aluminium, by Deville, must not be forgotten. In connection with Morris and Company, there are some beautiful specimens of aluminium exhibited, and also some aluminium bronze; the process of extracting this metal, and preparing its alloys, are illustrated.

Chapuis Brothers exhibit an interesting collection of rare metals; and a similar series is exhibited by Desmoutis and Co.

The practice of boring has been carried out far more scientifically in France than it has been in this country. There are, therefore, some admirable illustrations of the implements employed. Kind—who is so well known, in connection with the well at Passy—Degousée and Laurent, Mulet, Son, and Dru, may be named as exhibitors of several descriptions of tools and other appliances, which should be attentively studied by miners in this country.

In connection with the mineral deposits, and the means of reaching them, must be named the ventilating apparatus of Lemielle. This machine is composed of two cylinders of different diameters placed eccentrically one within the other; the smaller cylinder turns on a fixed axis in the interior of the larger cylinder, and in rotating carries with it moveable flaps or blades which traverse and fill the vacant space comprised between the two cylinders; the angular part of the axis occupies the centre of the larger cylinder, and conducts without friction the extremity of the moveable leaves or flaps by means of iron rods which are connected by a hinge to the elbow of the axle, whilst the opposite extremity assumes different degrees of inclination on the smaller cylinder; these fans serve the purpose of pistons and valves, which act without falling, and also without noise or shock. Two openings occur, one opposite the other, on opposite sides of the larger or outer cylinder, so as to allow the doors or pistons to exhaust the air from one side, and drive it out at the other.

This machine requires the least amount of force to produce a given effect; it exhausts 972 cubic feet of air at each revolution, its dimensions being 12 feet in diameter, and 6 feet in height; but a machine 15 feet in diameter and 7½ feet in height, will exhaust 2000 feet at each revolution; where required it may be adapted to exhaust much larger quantities of air; and on account of its small cost and extreme simplicity is much recommended.

In addition to its use as a mine ventilator, when used of smaller dimensions, it can be applied to cupola or other furnaces, in the place of the ordinary *fan-blower*, thereby saving one-third of the quantity of fuel.

The machine is here represented on a small scale, occupying only 81 square feet (*this space being assigned to the exhibitor*); it may be seen in action on a large scale at the Coal Works of Messrs. Abbott and Knight, Ashton Vale, Bristol, where it is worked with great success. Fifty others are worked in France, Belgium, and Germany.

The price of the ventilator exhibited is 40*l.*; one constructed to exhaust 270 feet per second, 200*l.*; and 540 feet per second, 400*l.*

The collection of chemical products is of a high character. It is impossible to particularize. A few only of the exhibitors, whose products possess some special features of novelty, can be named.

Besançon Brothers are exhibitors of white lead of a fine quality, and they have introduced improvements in the process of grinding this preparation, by which the workmen are protected from its injurious influences. Bruzan and Co. also exhibit fine white lead, and a zinc white of increased density or body, thus overcoming one of the objections to the use of this compound as a pigment.

The Chinese have long produced a fine green paint, known as the Lakao, from the buckthorn—*Rhamnus catharticus.* Charvin has apparently been successful in obtaining the same colour. There are several exhibitors of the aniline colours; but nothing is shown which has not been already described in the English collection, except the transformation of nitrobenzole into a red dye, by F. Laurent and Casthelaz, and the production of *murexide*, the Tyrian purple of the ancients, on a commercial scale, by Petersen and Sichler.

Arsenical greens have been objected to—a new chromium green of great beauty has been introduced. It is known as *Guignet's green*; it is manufactured on a large scale by Kestner, and some fine specimens are exhibited.

Mr. Crookes, the editor of the "Chemical News," is the discoverer of Thallium (vol. i. p. 115). M. Lamy exhibits a considerable quantity of this metal, and he has discovered new and abundant sources of it.

The salts of another new and rare metal, *rubidium*, are exhibited by Lefebvre.

The pharmaceutical preparations present nothing remarkable.

Amongst the *substances used as food* exhibited by the French, we can only state that the numerous agricultural societies and associations are large exhibitors of cereals of all kinds, hops, and other things. The Society of Acclimitization are exhibitors of animals and vegetables acclimatised, or in the process of becoming so. This collection is of special interest and should be more carefully studied.

Several illustrative series of fruits and oils are exhibited. Honey, beet-root sugar, cheeses, chocolate, coffee, confectionery, and a variety of other articles are exhibited in this class. These are articles and manufactures for which the French have long been celebrated, and the results are well known.

Again, the wines of France are very largely exhibited. A few may be enumerated: *Beaujolais*, *Yonne*, *Chateau Margaux*, *Drôme*, *Muscat*, *Bordeaux*, *Graves*, *Hermitage*, *Medoc*, *St. Emilion*, *&c.* There are some well-preserved samples of wines of different vintages, especially one of Hermitage of the year 1760. Kirchwasser is exhibited by several, and some excellent samples of brandies. The liqueurs was numerous, excellent in quality, and curious in name.

There is also a large exhibition of tobacco, but the finest contributions of this product are from the colonies.

In Class IV., section A., there are several exhibitors of candles and soaps.

In section B. there are many good examples of native wools, and cocoons of silk.

The Society of Acclimatization exhibit the results from ten new varieties of silkworm which they have introduced and cultivated in France.

The statuettes in ivory are, as might have been expected, fine examples of carving. The ivory and mother-of-pearl ornaments show much excellent workmanship.

M. Pinson is an exhibitor of imitations in gelatine of ivory and mother-of-pearl. The process is peculiarly his own; the results appear, however, to be very satisfactory.

There are some exhibitors of the indian-rubber hardened (*vulcanite*), and manufactured into combs and numerous other articles. Indian-rubber tubing, made without seam, shows much ingenious contrivance in the process of manufacture.

There are some beautiful applications of the *Bois durei* or hardened sawdust, and the votaries of the "Indian weed" will rejoice in the display of pipes, in wood especially, from the root of the *Erica arborea.* The sandal-wood fans are carved in excellent taste.

The flax and hemp exhibition is a good one, and the prepared fibre of *Sida textilis* by J. Itier, which plant he has naturalized in France for fourteen years, deserves much attention.

The perfumery of France is too well known to require any description.

Machinery.—At the entry of the French machinery department, is placed a tank locomotive adapted for drawing heavy goods trains on steep slopes, which has been built for the Northern of France Railway Company, by Messrs. E. Gouin and Co. It is mounted on four pairs of wheels, 3 feet 6 inches high, all of which are coupled together; the two steam cylinders and the whole of the valve gear are placed outside the framing; the boiler, which is unusually large, has a total heating surface of 1800 square feet, part of which is supplied by an extra superheater placed above the body of the boiler. This arrangement renders it necessary to adopt an horizontal chimney instead of the ordinary vertical form. The total weight of the engine when supplied with coal and water in running order is 43 tons. A drawing is also exhibited of the same principle as adopted in a four cylinder passenger engine. The Paris and Orleans Railway Company exhibit a passenger engine, in which the fire-box and grate are specially arranged for burning coal according to Tenbrinck's system. The grate bars are inclined at an angle of about 45°, and are terminated at the lower end by a short series of rocking bars, placed in a more nearly horizontal position. The furnace door is fitted with openings for the admission of air above the bars, and the fire-box is furnished with a tubular inclined bridge, placed nearly parallel to the bars. The engine is of an ordinary outside cylinder pattern, having a central pair of tall driving wheels; the valve eccentrics are placed on the driving axle outside of the connecting rod. A drawing of an eightwheeled goods engine, with the same kind of boiler, is also exhibited.

The representatives of the late Mr. Polonceau, exhibit a model of a locomotive ,with four pairs of wheels coupled together, driven by an extra shaft placed above the axles; designed for use on lines having curves of a small radius.

Messrs. J. F. Cail and Co.'s locomotive, is one intended for goods traffic, having three pairs of wheels 5 feet high, all coupled together; the axles are arranged so as to allow of a certain amount of lateral motion for passing round curves of a small radius. The cylinders and feed pumps are placed outside the bearings of the axles.

Two passenger carriages are exhibited by French makers; one is an ordinary 1st class carriage from the Paris and Orleans Railway, the other is a mixed carriage, containing 1st, 2nd, and 3rd class compartments, constructed for branch traffic on the Northern of Spain Railway.

Messrs. Gargan and Co., exhibit a tank railway carriage, intended for carrying liquid manure; it is placed on the frame of another carriage, furnished with a self-acting break made by Mr. E. Guerin, in which the breaks are attached to the buffer springs, and are applied to the wheels as soon as the buffers of the carriage come in contact with those on the adjoining one. The axles of Mr. Guerin's carriage are mounted upon friction rollers; the specimens exhibited have run a distance of about 60,000 miles without repair.

Another carriage with self-acting breaks, is exhibited by the Lyon and Croix Rousse Railway Company, which is used on an inclined plane worked by a stationary engine. Two different plans for stopping the carriage are adopted, which come into action in the event of the rope breaking; one is a band break, which works on a drum placed on one of the axles; the other is a pair of vice jaws, which fall on to the rail and are tightened up by the action of a double-threaded screw. Mr. Didier's break resembles that of Mr. Thomas Wright (vol. i. p. 227), where the stoppage is effected by a drag or sledge applied to the top of the rail.

Among the railway signals exhibited, we find one in which the signals at a junction are connected with the switches, and both are worked by the same set of handles; and another in which a line of signals, placed about a mile apart, are worked by the passing train without the intervention of any signal man.

A water crane for feeding locomotive tenders, provided with a cistern and heating-apparatus, designed for winter use in cold countries, is exhibited by Mr. Fauconnier.

The Paris and Orleans Company's locomotive and tender stand on weigh bridges constructed by Messrs. L. Sagnier and Co. Another locomotive weighing machine is exhibited by Messrs. Catenot, Beranger and Co.

Two pairs of marine engines are exhibited by French makers, the most important being a pair of horizontal screw engines of 400 nominal H.P. made by the Mediterranean Iron Ship Building Company of Marseilles. They are constructed with double piston rods, and have the eccentrics placed on an independent shaft, which is connected with the main shaft axle by means of spur wheels. A four-bladed screw is attached to these engines, and they are turned by a small horizontal engine, specially attached, during the exhibition.

Mr. Nillus of Havre exhibits a very compactly arranged pair of screw engines of 40 H.P., in which the double piston rod is adopted for the steam pistons, and the trunk principle for the air-pump rods.

The examples of fixed rotatory steam engines are principally of large size, the most important ones being those by Mr. Quillacq of Anzin, Mr. Lecouteux, and Messrs. Farcot and Sons.

Mr. Quillacq exhibits a pair of horizontal engines of about 250 H.P., arranged for raising coals. The steam cylinders are 24 inches in diameter, and 6-feet stroke. The rope drums are placed on the fly-wheel shaft without any intermediate gearing; a small vertical steam cylinder is attached for the purpose of working the breaks. Several whims of this pattern have been erected in the deep collieries in the neighbourhood of Valenciennes, and a detailed account of one is published in the Annales des Mines.

The engines by Mr. Lecouteux, and Messrs. Farcot and Sons, are employed in turning the main driving shafts for the French machinery in motion. Mr. Lecouteux's engine is fitted for working with high-pressure steam with expansion and condensation, and has an horizontal cylinder of 32 inches diameter, with a length of stroke of 54 inches.

Messrs. Farcot and Sons' engine is almost identical in dimensions and construction, both being of 60 H.P.

Messrs. Varrall, Ehvall, and Poulot, and Mr. Breval, exhibit small horizontal engines furnished with variable expansion valves.

Prince Polignac's engine is constructed on a very peculiar pattern, having a curved cylinder, in which the piston oscillates like a pendulum about a fixed point, carried on a special framing. This appears to be a new experiment, and no reasons are stated for the adoption of such a complicated construction.

Messrs. Lenoir and Co.'s new motor may be conveniently noticed in this place. It resembles an horizontal steam engine in outward appearance, but the motive power is obtained by alternately exploding a mixture of coal gas and air on each side of the piston. The explosion is effected by means of a small galvanic battery, which is alternately put in circuit with wires at either end of the cylinder by means of an insulated conductor sliding on the cross head of the piston. Two slide valves are employed, driven by eccentrics in the usual manner; one serving for the admission of the mixed gases, the other covers the ports, for the removal of the gases produced by the explosion. The cylinder is kept cool by a current of water, which circulates about its outer surface.

From a report on the mechanical effect produced by this engine, recently published by Mr. Tresco, the following data have been obtained.

The hourly consumption of gas per effective H.P. is 101·7 cubic feet. The ignition of the gases in the interior of the cylinder is effected at a temperature of 536° Fahrenheit, and about 175 gallons of water, at 64° Fahrenheit, are employed per hour in cooling the cylinder, the temperature being raised by the contact of the heated metal to 105° Fahrenheit.

It will therefore be seen that there is no economy to be obtained from the use of this engine in the place of steam power, but it may be conveniently employed for the production of a small power in places where it is considered desirable to dispense with the use of steam boilers. Another, and perhaps more formidable objection is pointed out by Mr. Tresco in the fact, that a trace of nitric acid is invariably found in the products of the explosion, which results from the oxidation of a minute quantity of the nitrogen in the air employed, and which is likely to exert a destructive influence on the interior of the cylinder.

A tubular boiler with wrought iron tubes, and having the fire-box made of steel plates, is exhibited by J. F. Cail and Co.; Messrs. Laurens and Thomas, and Farcot and Sons, contribute others, in which the fire-box and tubes are attached to the outer case of the boiler by means of screw bolts, instead of being rivetted to it, in order to allow of their being more readily cleaned or repaired. This principle is also in use in England, and may be seen adapted to agricultural engines, in Biddell and Balks' boiler, shown by Ransome and Sims in the Eastern Annex.

An ingenious apparatus, called by the inventor, Mr. H. G. Wagner, "Hydratmo-purificator," is intended for purifying the feed water for boilers, by depriving it of the calcareous salts held in solution. This is effected by causing the water to pass over a series of broad shallow trays, where it is heated to a high temperature by a portion of the exhaust steam from the engine. The calcareous matter in solution is deposited in a thick scale on the rectangular plates, from which it can be easily removed. This machine is made by Mr. Durenne, who exhibits one of large size, and a smaller one attached to the boiler of a portable steam engine.

Mr. De Chodzko exhibits a new kind of fire-grate for steam boilers, which is reputed to be an excellent smoke consumer. The fire-grate is divided into two equal parts, the hinder one being placed about 9 inches below the front one; each is provided with a separate fire-door, the front one serving for the admission of fresh fuel, and the hinder one for clearing the fire of slag and ashes. The fresh fuel is coked on the front bars, and the gases produced during this part of the process are consumed by being passed over the ignited coke of a former charge spread out over the hinder grate, the requisite amount of air being admitted through special openings. A saving of 20 per cent. of fuel has been obtained in practice by the use of this contrivance.

Several kinds of float gauges for steam boilers are exhibited by French makers. One of the most ingenious is the magnetic indicator, by Mr. Lethuiller Pinel, in which the float is terminated by a rod, carrying a small permanent magnet, the poles of which are in contact with the back of a thin metallic dial, and cause a small iron pointer to be carried up or down on a divided scale, according to the variation of the water level.

The principal exhibitors of metallic pressure gauges are Messrs. Desbordes and Rondeau, Mr. E. Bourdon, and Mr. E. Clerc.

Messrs. Fontaine and Brault exhibit two turbines, constructed on the newest modification of Fontaine's principle. The larger one is intended to produce a mechanical effect of 4 horse-power, when working under a fall of water of 52 inches, and also to produce the same amount of power when working with an increased quantity of water, but with the fall reduced to 28 inches during the summer flood time. The guide curves are placed above the wheel, and are closed by a flexible band of gutta-percha, which can be rolled on to a conical roller by means of a rack and pinion work, so that the admission of the water to the wheel is effected through the full aperture of the number of guide curves in use. The provision for working with a variable quantity of water consists in furnishing the wheel with a double set of buckets; the inner series are closed by a set of iron plates fitting the top of the buckets when running under the higher fall in slack water time; when the fall diminishes, and the water increases in flood time, the plates are removed, and both systems of buckets are employed. The smaller wheel by the same exhibitors is constructed for producing a useful effect of 7 horse-power, with a fall of water of 195 feet ; the admission is effected through two guide curves only, as it is intended to be used with a very small quantity of water.

The show of machine tools by French makers is but small. Messrs. Varral, Ehvall, and Poulot have sent a small planing-machine and a steam-hammer on Naylor's patent. Another steam-hammer is sent by Farcot and Sons; a machine for shaping the spokes of wrought-iron railway wheels, by pressure, by De Dietrich and Co.; and a combined piston and cam-hammer, by Schmerber Brothers, complete the list of metal working machines.

Wood working machines are more numerously represented. Among them will be found a portable saw-frame by Mr. P. A. Frey; moulding and tenoning machines, and a circular saw by Bernier and Arbey; and a band sawing machine or endless ribbon saw, capable of cutting out curved forms of the most irregular and complicated characters, by Mr. J. L. Perin.

Messrs. Varral, Ehvall, and Poulot exhibit a portable band saw-bench, with an engine and small vertical boiler attached.

A large collection of wool preparing, spinning and weaving machinery, is exhibited by Mr. A. Mercier, including circular and gill-combing machines, an opening machine for carding wools, condenser and other carding engines, drawing and throstle frames, and a mule frame of 210 spindles. Two different varieties of looms are also exhibited in this collection.

Two novelties will be found among the looms exhibited; one is a model of the arrangements of the electro-magnets in a loom on Bonelli's system ; the other is a project by Mr. M. E. Mouline for replacing the ordinary picking motion by a travelling magnet, carrying the shuttle across the warp at a low speed and with an equable motion. In order to compensate for the low rate of speed, the inventor proposes to use looms of much greater breadth than are usually employed at the present time.

Giffard's injector for steam boilers is exhibited in various sizes by Mr. H. Flaud; several of them are arranged for lifting water from a tank in order to show the method of working. This curious machine is distinguished from all other pumps or hydraulic engines, by the total absence of piston, valves, or other moving parts, the motive power being a steam jet which acts directly on the water. It is founded on the principle of the lateral communication of motion from one fluid to another, in the same manner as a jet of steam is made to draw air in ventilating, or a water jet carries down air in the Catalan blowing machine. The steam issues from a tube contracted conically to a fine circular aperture, into a second conical tube somewhat larger than the first one, which is in communication with the feed water cistern, placed at a level from 3 to 6 feet lower. By virtue of the power of lateral communication, the steam issuing from the first cone draws up a stream of water, by which it is condensed, and a jet of water is sent forward through the second mouth-piece with a velocity depending upon that of the original steam and the quantity of water lifted. Immediately in front of the second mouth-piece, at a distance not exceeding 4-10ths of an inch, is placed a third conical tube, the sides of which are sloped at a very acute angle to the vertical, the small end of the cone being uppermost, a direction the reverse of the former ones. Through this last tube the jet of water is carried with a velocity sufficient to open a valve which is placed at its lower part, and is kept close by the pressure of the steam in the boiler when the injector is not in use. In order to understand how it is that the steam taken from the upper part of the boiler can force water apparently against its own pressure, a numerical example is added here. Supposing the steam to be at 75 lb. pressure, it will issue from the boiler with the velocity of about 1700 feet per one second of time, and it will require for its complete condensation a mass of water of the temperature of 60° Fahrenheit, about thirteen times larger than itself, the temperature of the water after the condensation of the steam, being 150°.

By taking the mass of water at 15 times that of the steam, the temperature after condensation will be 136°, and the resulting velocity about 110 feet per second, with which the water would travel towards the boiler.

The water in the boiler, on the opening of the injection valve, would issue with a velocity due to the excess of the pressure of the steam over that of the atmosphere, or about 60 lb., which is equal to a speed of about 90 feet per second, or 20 feet less than that of the opposing stream from the injector. In addition to its use for feeding steam boilers, the injector has been applied in a few instances as a pump, but this is to be regarded as a wasteful method of applying the steam power, except in cases where hot water is required.

Mr. E. Bourdon exhibits a series of models in illustration of his claim to priority of invention of the injector over Mr. Gifford, having employed a similar arrangement as early as the year 1847.

The centrifugal pump by Mr. Bourdon is of a very novel character; it differs from most of the forms now in use, by having no guide, curves, or buckets in the rotatory portion; the water is introduced near the centre of a hollow rotating drum, from which it is thrown out through one or more fixed discharge pipes or syphons, curved to the form of the buckets of an horizontal water-wheel. This principle can also be applied to the construction of fan-blowers; one of these is exhibited, capable of furnishing air at a pressure sufficient for working a charcoal iron blast furnace.

Mr. Bertholet, of Troyes, exhibits circular and rectilinear knitting-frames, constructed on patterns which are now largely employed for the manufacture of all kinds of hosiery; some of the finished specimens of silk gloves, &c., are interesting, as showing the fine character of the work which can be turned out by these machines.

A fishing-net loom by Bedouin and Co. is constructed on a plan suggested by Messrs. Buron and Pasquier; it has 50 needles, and is capable of forming 70,000 meshes per hour.

Several varieties of sewing-machines, including one which can be worked at pleasure with either one or two threads, will be found in that portion of the French Court which is situated under the Picture Galleries.

A new kind of Jacquard apparatus for looms weaving richly figured fabrics, working with only one half of the number of cards usually employed, is exhibited by Mr. Ronze.

In another plan shown by Messrs. Durand and Pradel, the perforated pattern is made of a continuous web of paper, instead of using a chain of cards. This alteration is said to produce a saving of two-thirds in the price of the pattern.

Machinery for sugar makers and refiners is very completely represented in the collection exhibited by Mrs. Derosne and Cail, including a cane mill with an horizontal steam-engine of 25 H.P. attached; a triple effect vacuum-pan capable of boiling down 2,000 gallons of cane juice per hour, having the air-pumps driven by a beam engine; a large vacuum apparatus for producing granular sugar; a series of boilers for defecting and purifying the juice by means of lime and carbonic acid gas; and two filtering vessels, for filtering syrups through animal charcoal. A direct-acting air-pump driven by an horizontal engine is placed underneath the platform of the vacuum-pans. A model of a vacuum-pan for making granular crystals of sugar is shown by Mr. F. Legal.

A large distilling apparatus is also included in Messrs. Cail and Co.'s collection; another, by Mr. Egrot, is placed among the machinery in the court under the Picture Galleries.

A pair of large-bore and short-stroke lifting-pumps suitable for draining land, &c., are exhibited by Mr. Letestu; a pair of force-pumps of a similar character are sent by Farcot and Sons.

Mr. Hubert's pumps, which are employed in supplying water to the fountains in the Horticultural Gardens, are placed among the English machinery near the locomotives.

Mr. Perreaux's pump valves, which are exhibited in both the English and French departments, are made entirely of vulcanized india-rubber, in the shape of a tube tapered down to a pair of lips which enable the valve to open and close with the slightest variation of pressure. The water way of the valve is very large, and the elasticity of the material causes it to shut immediately the pressure from below is removed.

Messrs. Carré and Co.'s ice-making machines are among the most striking objects in the foreign part of the Western Annex. They are of two kinds, one being continuous, and the other intermittent in action; but the principle involved is the same in both cases, namely, the production of cold by the volatilization of a gas which is easily liquefiable, and, at the same time, in a high degree soluble in water. The smaller, or intermittent apparatus consists essentially of a pair of distilling and condensing vessels, united together by an air-tight joint, and capable of resisting an internal pressure of 150 lbs. to the square inch. The distilling vessel is filled with a watery solution of ammonia, at the maximum point of saturation. By the application of heat, the ammoniacal gas is driven off, and passes over into the receiver or condensing vessel, where it is soon liquefied by the constantly increasing pressure of the gas given off by the watery solution, a pressure of 97 lbs. to the square inch being sufficient to effect the liquefaction of the gas, when the temperature of the vapour does not exceed 50° Fahr. When the condenser is filled with pure fluid ammonia, the distilling vessel is removed from the fire, and is immersed in a vessel of water at the ordinary temperature of the air. By this means the water remaining in the distilling vessel is slightly cooled, and it immediately redissolves the column of ammoniacal gas standing above it, a vacuum is formed, and the liquefied gas immediately begins to distil back and redissolve. The heat necessary to effect this redistillation is abstracted from the water to be frozen, which is contained in a cylindrical mould, placed in the internal tube of the annular condensing vessel. The time required for producing 1 lb. of ice, in the smallest size of the portable apparatus is 55 minutes; 25 minutes being required for the preliminary, and 30 minutes for the reverse distillation; it is during the latter period that the ice is produced. About four pounds of ice are produced for every pound of fuel consumed in the preliminary distillation.

The continuous apparatus is more complicated in construction; it consists of a boiler or distilling vessel, with the addition of a rectifier, formed of a series of horizontal tubes in which the gas is freed from the last trace of water, by a current of weak ammonia water circulating in the opposite direction. From the rectifier the gas passes to a serpentine tube, forming part of the boiler, and thence into the condenser, a series of tubes cooled by a current of water to 60° Fahr. Here the gas is liquefied, and is driven over by the pressure in the boiler into a regulator, from which it passes into the freezing vessel, also formed of a series of spiral tubes, which are surrounded by a solution of chloride of calcium; the moulds containing the water to be frozen are placed in a vibrating frame, in order to cause the ice to form more rapidly. The return current of ammoniacal gas from the freezing vessel is passed over by an exhausting pump into a receiver, where it is redissolved in the spent water drawn from the boiler. The ice produced in the continuous apparatus varies between eight and fifteen times the weight of the fuel consumed: about a gallon of condensing water is required for every pound of ice produced.

Mr. J. Lecointe exhibits a regulator for hydraulic presses, similar in principle to the hydraulic accumulator of Sir Wm. Armstrong.

Several new varieties of kneading-machines, for bread-making, will be found in the Court under the Picture Galleries.

Messrs. Cail and Co., and Mr. Fauconnier, contribute examples of Neustadt's crane, in which a flat link chain, like a watch chain, gearing into a toothed wheel, and having the weight suspended to a similar toothed wheel, hanging in the loop of the chain, is employed instead of a winding drum.

This crane is becoming very popular, having been adopted in the naval arsenals of France, and by many French railway companies.

The collection of grinding machinery is very large and important. The most interesting article in this Class is a model of six pairs of mill-stones, driven by toothed gearing from a central shaft, made by Mr. C. Touaillon.

Messrs. Cazenave and Co. exhibit a continuous brick-making machine, in which the clay is moulded between a pair of felt-covered rollers of large diameter; the stream of moulded clay is divided into bricks by a series of cutting wires, mounted on a rotating frame.

Mr. Devinck's machine for papering, folding, and sealing packages of chocolate is worthy of attentive examination; but it would not be possible to give any idea of the construction of this machine, without entering into an analysis of the mechanical motions employed, which could scarcely be done without the use of illustrative figures.

A very important collection of models, plans, and drawings of some of the principal engineering works, recently constructed in France, which has been formed under the direction of the Ministry of Public Works, will be found in a court on the south side of the nave near the western dome. The collection includes a large lighthouse lantern, a model of an iron lighthouse for the Island of New Caledonia, a model of Cherbourg breakwater, several graving docks, and similar works executed for the principal government arsenals, and a large collection of bridges, &c. The most important of these is probably the iron lattice-bridge over the Sarine Valley, on the Fribourg and Lausanne Railway, of six spans, each of 158 feet in width, supported on tapering lattice-work pillars, at a height, in the centre, of 247 feet above the river. No scaffolding was employed in the construction, the girders having been put together and pushed out from the abutments; the iron work of the piers was then lowered into place from the overhanging ends of the girders. The bridge over the Garonne at Bordeaux, and that over the Rhine at

Kehl, near Strasburg, are also works of great magnitude; in both cases the sinking of the hollow iron pillars forming the piers was effected by means of compressed air.

Another model, which is worthy of particular notice, is the section of the artesian well of Passy, near Paris. This well was commenced in 1855; on the 23rd of September, 1861, a water-bearing bed of sand was reached at a depth of 1924 feet below the level of the ground. At the present time the supply of water amounts to nearly 1,200,000 gallons daily, delivered at a height of 78 feet above the level of the ground, or 2000 feet above the bottom of the bore hole. The model shows the section of the beds passed through, made of the materials actually extracted, and the kind of tubing employed in lining the bore hole. Models of the tools employed are also shown on a scale of one-tenth of the actual size. The boring was conducted by the well-known German engineer Mr. Kind.

The principal works in masonry, of which models are shown, are, the viaduct of Chaumont, built in three tiers of fifty arches like the old Roman aqueducts; the viaduct of Nogent sur Marne, which has thirty arches of 48 feet, and four of 162 feet width of span; and the bridge of Saint Saveur, of one single semicircular arch of 136 feet span, placed at a height of 220 feet above the waters of the torrent of the Gave de Pau in the Pyrenees.

There is but a small collection of agricultural implements from France. Two or three of the threshing-machines are good; the reaping and mowing machines are well constructed, and Chambarl's *vanne autorégulatrice* for irrigation purposes is ingenious. The articles shown for architectural beauty by the French exhibitors are select, but many of them very beautiful. The collection of models—drawings and designs relating to the Public Works of France—which have been selected under the direction of and exhibited by the *Ministère de l'Agriculture du Commerce et des Travaux Public*, form an excellent school of themselves. Many of these things have been already named and described. The drawings of works by the "*Service*

Municipal" for improving Paris, display much artistic ability in the arrangements adopted.

Amongst the other articles exhibited in this Class, the works of art and utility made by Lippmann, Schneckenburger & Co., in their artificial composition, called *Similimarbre* and *Similipierre.* The applications of this beautiful material are numerous. It is thus described by the inventors :—

"Le *Similimarbre-Similipierre* est un produit moulable, hydrofuge et incombustible, d'une contexture filamenteuse qui lui donne une grande force de cohésion. Suivant ses diverses préparations, il imite la pierre et le marbre, dont il a la dureté, l'apparence et les propriétés. Il reproduit tout ce qui est du ressort de la sculpture et peut recevoir le plus beau poli.

"Le *Similimarbre-Similipierre* est destiné dans toutes les applications à remplacer avec avantage comme solidité, beauté, aspect et résistance extérieure, les plâtres, terres-cuites, pierres factices et pâtes d'ornementation. Quelques-uns de ces derniers produits ne sont nullement hydrofuges et certains autres ne peuvent pas satisfaire, à raison de la cuisson qu'ils doivent subir, à toutes les exigences de forme et de précision auxquelles se prête le *Similimarbre-Similipierre* qui, complètement travaillé à froid, reproduit avec l'exactitude la plus mathématique tout ce qui est du ressort de la statuaire, de la sculpture et de l'architecture.

"Le *Similimarbre-Similipierre* résiste à toutes les intempéries, il n'a besoin de recevoir aucune peinture, ce qui permet de lui laisser tout le fini et l'aspect de la pierre et des marbres sculptés.

"Le rapport officiel de M. Michelet, ingénieur en chef des Ponts-et-Chaussées, en date du 27 octobre 1860, classe le *Similimarbre-Similipierre* au rang des bons bancs francs des environs de Paris, des pierres d'Euville, de Saillencourt et autres matériaux employés en soubassement dans les édifices. Sa résistance à l'écrasement est de 161·08 kilos. par centimètre carré."

F. Coignet Brothers & Co. are also exhibitors of an artificial stone called *Beton agglomere*, which has much merit.

Monduit & Bechet exhibit ornaments manufactured by a process invented by Antonie Durant, of an alloy of lead and copper. L. Grados are exhibitors of ornaments of superior workmanship in embossed zinc and lead. H. F. Michelet is an exhibitor of similar productions of equal merit.

The Terra Cotta ornamental works, and those in stucco, must also be commended.

The *Carton imperméable*, the Silica painting, the hydraulic mastic, the so-called porcelain cement, the encaustic, the cement called *néolithe*, which is employed in the place of bitumen for pavements, are each in their special way of excellent character.

France, as a military nation, makes but a small display of arms and ordnance. There are many excellent rifles, guns, and pistols, but nothing requiring any special description. In naval architecture the collection is yet more limited.

Philosophical Instruments, or, as the French term them yet more appropriately, "Instruments de Précision," are exceedingly well represented. There are some applications of the electric light. The electro-magnetic light of Berlior and Company has many features of novelty, and it is remarkable for the simplicity of the construction of the instrument. V. Serrin exhibits his self-regulating electric light, in which there is much ingenuity displayed. The printing electric telegraph of Dujardin, and the originality of the construction of the telegraphic apparatus of Digney Brothers & Co. are to be commended. The name of Duboscq is sufficiently familiar to all who are engaged in scientific inquiries. He exhibits some exquisitely beautiful and delicate optical instruments. Those of Rardon are very fine; and the polarizing prisms and crystals exhibited by A. S. Bertaud, are amongst the most perfect ever executed. The collection of Bréquet, embracing almost every variety of surveying instruments; the printing telegraph of Guyot D'Arlincourt; the secondary pile of Gastor Planté; chronometers and numerous other instruments of precision cannot be too highly commended. Amongst other articles to which attention should be directed, the dividing engine of L. G. Perreaux must be named; the calculating machine of C. X. Thomas; the acoustic apparatus of R. Kœnig; and the beautiful dioptric apparatus of Lepaute & Sautter, which is exhibited by the Minister of Public Works. M. Chuard exhibits a safety-lamp for use in coal-mines, simple and ingenious. His gazoscope "*instrument pour prévenir les explosions dans les mines*," has some novelty about it, but it can only be regarded as an indicator, and is so far useful. The "barometers metallique," or aneroid barometers of Naudet & Co., appear to possess the best qualities of these instruments. Everything of course depends upon the uniform elasticity of the barometric vase, and the arrangements made will probably secure this as perfectly as in any that have been constructed. The balances exhibited are of a very first-class character. Those of M. and A. Collot are excellent. The spring weighing-machines of Taurines display much ingenuity. The microscopes must also be examined, many of them being highly commendable.

The photographs produced in France are exceedingly well known in this country. For years we have been familiar with the panoramic views of Mont Blanc, by Bisson Brothers. We discover two Englishmen amongst the French exhibitors; these are Mr. Maxwell Lyte, and Mr. R. Bingham: these works are excellent. The views of the Pyrenees and those from Egypt are especially interesting. The enlarged photographs of Viscount Aquado, and the large views by Baldus, of monuments, are fine examples. A. Poitevin exhibits his carbon photographs, and Garnier & Salmon have also a carbon process invented by themselves. Niepce de St. Victor, who is nearly the only man in Europe who is still pursuing the science of photography, exhibits some fine samples of his heliographic engraving on steel. C. Négre has also some productions of similar character. M. Niepce has perseveringly employed the bitumen of Judea, which was used by his relative, N. Niepce, and by Daguerre, at least fifty years since. There are some interesting pictures obtained upon the nitrate of uranium, and Heliochromes produced by the process introduced by M. Edmond Becquerel. Lafon de Camarsac has photographs on porcelain, which have been subjected to vitrification. Taupenot exhibits the process published by him in 1855. The instantaneous pictures of animals by Crémiere, and his pictures obtained by the agency of the electric light, are of a very interesting character. Of course stereoscopes form an important part of the Photographic Exhibition, which is highly creditable to the French school.

Musical Instruments.—These are exhibited of every kind and of every degree of excellence. They have been carefully examined, and although many of the pianos show ingenious contrivances and high-class workmanship, there is little that requires any special description. "Richness and roundness" of tone are especially commended in them by the Jurors. Harmoniums are exhibited by many. Alexandre and Son show some novelties in the construction of their harmoniums which have a fine quality of tone; and H. C. Beaucourt introduces an invention for producing a forte effect by an increased depression of the keys, and simplification of the mechanism of the stops.

Brass instruments, flutes, and clarionets are pronounced by competent judges to be of high character. Triebert has a medal awarded for the first application of Böehm's system to hautboys, clarionets, and bassoons.

Horology is well represented: it is, however, curious to find the Jurors qualifying the French watches as of "fair workmanship."

Surgical instruments are commended, and to those interested will be of much interest.

The Classes devoted to Textile Fabrics must be briefly dismissed.

Cottons are exhibited, as yarns, threads, and a considerable variety of woven fabrics.

Flax and Hemp, coarse and fine, have many exhibitors; cambric of great excellence is exhibited by Buchholtz and Co., Delame-Lelievre, Goddard and Bontemps and Guynet. The table-linens of J. Casse and Son are good. The coloured sewing-threads of Verstracte and Co. are excellent.

Silk.—The silk manufactures of France are too widely known to require any description. The raw and thrown silks, and all the varieties of manufactures have been most carefully selected. Nothing can exceed the general excellence of manufacture. The beauty of colour is complete, and in the harmonious combination of tints England has yet much to learn from her French neighbours.

The velvets are no less excellent than the silks.

Woollens.—Here again France makes a noble display. The tapestry furniture coverings are excellent in manufacture, and chaste in design. Boutarde and Lassolle must be especially noted for the handsome collection of woven shawls, elaborate in design and perfect in make, and for a most successful striped shawl made by Epouliné weaving on an improved principle. Duché, Jun. Brierre, and Co., are also exhibitors of shawls: these are stated, by the best judges, to be of extraordinary manipulation in weaving: being Indian wool-yarn, the finest ever spun, the brilliancy of tints and the beauty of design are of the first order. Fred. Herbert, Jun. must also be noted for most perfect regularity in weaving with Indian wool-yarn of the first class; the classic and harmonious imitation of the Indian style and most successful colouring. This exhibitor has introduced a new process of weaving in imitation of the Indian make. The Utrecht velvets will be admired. The miscellaneous collection of woollen fabrics cannot be too highly commended.

Carpets.—The Imperial manufactories of the Gobelins, the Savonnerie and of Beauvais are the great exhibitors. The artistic excellence of those—many of them most extraordinary productions—is well known. The manufacture of those beautiful fabrics being confined mainly to the government works, there are but nine other exhibitors: Baudin Brothers are exhibitors of plain and printed waxed cloths; Cautel and Co. show leather cloth; and Le Crosnier displays fabrics of cotton, flax, and of silk gummed or waxed, so that the exhibitors of carpets proper are very limited.

The Gobelin works exhibited are, the Assumption of the Virgin after Titian; and a portrait of Louis XIV. after

Rigault. The Savonnerie have several works in the Renaissance style and that of Louis XVI., while from the works of Beauvais we have the attributes of the chase, and works in the styles of Louis XV. and Louis XVI., which are designed for the Imperial Palace, the compositions being by H. Chabal-Dussurgey. Several beautiful works have been executed by the manufacturers exhibiting in this Class, for the residence of the Imperial Commission in London.

Printing and Dyeing.—What has been stated already respecting the harmonious arrangement of colours in French works applies especially to the illustration of printing and dyeing. Amongst the novelties must be named the engraving by etching exhibited by Feldtrappe Brothers, who have adopted a method by which various shades can be obtained. Guinon, Marnas, and Bennet have some fine illustrations of their discovery of the *pourpre française* derived from lichens, for the application of which a Medal has been awarded them. Also for the application of the new blue (*azuline*) which is derived from carbolic acid. Renard Brothers have made some very delicate applications of the new red blue and purple colours derived from aniline, the new red being their own discovery. Did space admit of it, much might be written on this section of the French exhibition, there is such evidence of care and skill in every division of the different processes.

Lace.—The machine-embroidered muslins and cambrics which are exhibited are of considerable excellence, as is also the machine-made net. The exhibition of the point lace D'Alençon is of a very high character, and that of Valenciennes no less so. The real and artificial laces are really remarkable as a collection, but the French laces are too well known to the ladies of England to require any description.

Fur, Feathers, and Hair.—In this small class there are some fine examples of manufactured furs and skins in Russian sable, grebe, silver, and white fox and seal. There is also a large and curious assortment of rabbit skins, natural and dyed.

Ostrich and other feathers are also exhibited, Hénoe exhibiting a parasol made of marabout feathers, the stalks of the feathers forming the ribs of the parasol.

Some very superior workmanship in hair jewellery is exhibited, and a few well-made articles for the toilet and other purposes to which hair is applied.

Leather has several excellent displays: the exhibitors of the French kids especially have been most successful. Saddlery and harness are but imperfectly represented.

Clothing in all its divisions may be made to give place to articles which more especially require attention.

Stationery and Printing—present nothing of sufficient importance or novelty to require description: there is much that is excellent and highly creditable to the presses of the empire in the way of printing, chromo-lithography, and wood engraving. The papers are good, and the ornamental stationery is of the most tasteful character.

The Educational works and appliances possess many most important objects. The Imperial Schools of Arts and Manufactures at Aix, at Angers, at Chalon-sur-Marne, the Imperial Institutions for the Deaf and Dumb at Bordeaux and at Paris, and the Institution for Blind Children, each display their productions, and they are most creditable to all concerned. The Acclimatization Society has been already named. Amongst the strictly rudimentary educational works must be noted the geographical maps and books by Babinet and the models and plans of Bardin for teaching geology and topography. Carpentier exhibits his ingenious method of practically teaching the system of standard weights and measures.

Amongst the higher-class productions there are the fine anatomical preparations of Dr. Auzoux. The fine collection of natural history illustrating instruction in agriculture, exhibited by the Normal Agricultural Institute of Beauvais. Parzudaki has a good collection of stuffed animals. The Prévost Florent has a remarkable collection which exhibits the different kinds of food of the birds of France. This is a collection which cannot fail to be pre-eminently useful in agricultural education.

To pass over many most important productions and useful works, we must refer to the drawings and models produced by the Municipal School for Drawing and Sculpture in Paris; they indicate art education of a very high class. There are some others of nearly equal excellence. It is to instruction of this character that the high class of the art workmen of France is due. Altogether, this educational collection merits the most careful study.

Furniture, &c.—The art of decoration and of the manufacture of decorative furniture, is pre-eminently one in which the French excel. There is every description of furniture in almost every style, the inlaid and carved furniture being peculiarly excellent. The paper-hangings are excellent in design and in manufacture. The ebony work is exceedingly fine.

J. Dufresne exhibits in this class his specimens of Damascening with gold on steel and iron, in which there is much novelty and considerable beauty.

The Manufactures in Iron and other metals are well illustrated. Cast-iron railings and other ornamental works in this metal deserve much commendation. The iron tubes of Bouttevillain are excellent. The unsoldered copper and brass tubes of Estivant Brothers are of most excellent quality, and many of the brass castings are of the most artistic character. Buttons of various descriptions show great excellence of manufacture and considerable variety in design.

The bronzes of France are excellent. The works of Barbedienne are remarkable as being successful reproductions in bronze of many of the finest examples of antique sculpture. The castings of bronze and silver are most delicate; the chasings are executed with the most consummate taste, and in the combinations of silver, enamel, bronze, and the Algerian onyx for articles of luxury, this display cannot be surpassed. G. Denière exhibits bronzes of very large dimensions, and combines with much taste the onyx marble in his works for decorative furniture, as well as for figures. Durenne shows a perfection in moulding which can scarcely be excelled. The delicacy in the features of the iron figures cast by him is remarkable. L. Lerolle combines with much artistic effect the onyx and bronze. This exhibitor has some most skilfully manufactured chandeliers and lamps of antique style. It is not doing justice to the numerous exhibitors of bronzes to select a few names. There is not that difference in the execution of these works which will justify this, yet it is not possible to name all. The entire collection of bronzes, of iron statues and ornamental works, and of artistic productions in zinc, will command the admiration of all. The beautiful fountains in the gardens of the Horticultural Society, by Durene and Barbazate, must not be forgotten. Altogether, the ornamental castings, whether we look at the works of art, the bronze statues, or at the many admirable examples of art-manufacture, such as the chandeliers, candelabra, &c., must be pronounced to be of the highest class.

The exhibition of ordinary hardware is of considerable merit, but this class of manufacture cannot be compared with the English, as examples of either workmanship or of mechanical skill.

Steel.—In steel jewellery, Bourgain is pre-eminent; design and workmanship are alike good. There are a few good assortments of ordinary cutlery, some excellent files, and excellent specimens of steel pens.

Works in Precious Metals.—In the centre of the French Court, Ch. Christofle and Co. place their magnificent centrepieces of plate, which have been executed for the fêtes at the Hôtel de Ville, of Paris. This fine composition has been executed under the direction of M. V. Baltard, Director of Works, and Inspector of Fine Arts. The emblematic figure of Paris is mounted on the bridge of a vessel, supported by four caryatides, representing Science, Arts, Industry, and Commerce. The eagle draws her onward to her future destiny, the genius of Progress guides the path, while Prudence is at the helm. The extremities of the composition are occupied by sea-horses and tritons. The execution of this work is of a superior character. The same firm exhibits numerous other articles of silver and gold work. Two candelabra of the style of Louis XVI. are much admired. There are works in aluminium and in aluminium bronze (these metals have been already described), and many admirable works by the electrotype process. The devotional articles in gold and silver exhibited by Armand Colliot, and the church plate shown by L. C. Bachelet, are well worthy the closest attention. P. Poussielque exhibits some exquisite works of a similar character. The Chasse of Notre Dame, designed by Leduc Viollet, has great artistic merit; and the font exhibited by Bachelet, designed by this artist, is of the finest character. Barbedienne has numerous productions in silver plate of great beauty, and we may also mention as examples of gold and silversmiths' work, productions of Aucoc, Duponchel, Fanniere, Gùeyton, and Odiot. The jewellery is very fine: it is remarkable for the excellence of workmanship and the lightness and beauty of design. The historic jewellery of E. Granger is deserving of especial attention. In imitation jewellery Paris has ever excelled; much that is now exhibited is of the highest class of this manufacture. The imitation pearls of C. E. Truchy are really curious in the perfection of the result obtained. This manufacture has long had its seat in Paris. The *Essence of the East*, which was a preparation of the scales of the Bleak, was manufactured in that city long ago, and with this then, as now, factitious pearls have been made. The cameos, especially the onyx cameos, are very beautiful; the Damascened works in gold and silver are of first-class workmanship, and altogether the productions of this class are singularly attractive.

Glass.—The stained glass, which are arranged in the French gallery, are generally of excellent execution, and many of them display high artistic merit. In the ordinary glass there is nothing of especial merit to notice. H. Brossette & Co. have been very successful in precipitating silver from its salts on glass by the agency of tartaric acid. Various agents have been employed for the same purpose in this country, and in many cases the results obtained were good, but the process has not secured a permanent place as a manufacture.

Pottery.—It is not necessary to describe the well-known production of the Imperial manufactory of Sèvres, the novelty of the present beautiful exhibition being the "pate sur pate" enamels. The inlaid porcelain of Gosse is very curious; it is known in France as "porcelaine dure allant au feu," and is by many much admired. The decorative porcelain generally is good, and the examples of the style of Bernard Palissy, the potter, by Avissea, are excellent.

Class XXXVI. is one in which French workmen excel, and the dressing-cases, portemonnaies, cigar-cases, bags, &c., are very elegant in design and of good workmanship.

THE FRENCH COLONIES bring many curious and most instructive groups before us for study.

Guiana sends us cocoa, sugar, spices, and tobacco; cocoons and cotton; many animal products, feather manufactures, costumes, arms, &c.

St. Pierre and Miguelon send salt codfish and herrings, cereals and medicinal plants.

Cochin China, a small collection of colonial products.

New Caledonia exhibits coal, cotton, textile fabrics, grains, tuberous roots, wool, and products of her fisheries.

Tahiti and its dependencies exhibit woods, cotton, tobacco, pearl oysters, and pearls.

Mayotte and Nossi-Be come to us with rice, sugar, coffee and rum, tortoiseshell and wax.

St. Mary of Madagascar has a small collection of her products.

The French East Indies display medicinal substances, cereals, fruits, preserved fish, manufactured articles in cane and straw, cotton and silk, mixed fabrics, and boots and shoes.

The West Coast of Africa—Coffee, oleaginous substances, colouring matters and peltry, with arms and costumes.

Guadaloupe has some mineral products: flour, arrowroot, sugar, alcohol, preserves, liqueurs, and woven fabrics.

The Isle of Réunion has a similar collection, and *Martinique* adds to her colonial products a group of Martinique birds.

ALGERIA.

Amongst the metalliferous products from this important colony we have several examples of iron, copper, lead, zinc, and nickel. The onyx marbles are the most important of the earthy minerals. Gypsum and some other products of interest occur.

The chemical collection includes a great variety of medicinal substances, many excellent essential oils, orange-flower water, &c.

Cereals are largely exhibited, and there is an extensive collection of Algerian wines. Many good fibres are in the collection. Cochineal, kermes, indigo, madder, carthanium, tanning-bark, &c., are amongst the dye drugs. There are three exhibitors of agricultural instruments; some yarn and woven fabrics of Algerian cotton, flax, and silk: the Algerian wool is fine. Many skins are exhibited; some good specimens of coral, &c.

Costumes, furniture, and decorations show how rapidly this colonial dependency of France is advancing in the arts of civilization.

GERMANY.

Embracing—

1. **Austria.**
2. **The Zollverein.**

AUSTRIA.

Number of Exhibitors, 1410.

SITUATION IN BUILDING.—*The North-west Transept, and the North-west Transept Gallery.*

The mineral collection of the Austrian empire has been selected with great care, and arranged with much judgment. The Austrian Catalogue, of which a translation in English has been published, is full of valuable information on every point, and to it the reader is referred. It is impossible properly to describe, within the few pages at our disposal, the interesting metalliferous and earthy minerals shown.

Metals.—The amount of metals and metallic ores produced in 1860, stands as follows :—

	Cwt.
Antimony (metallic and ores)	**8,767**
Cadmium	**131,043**
Chrome ores	**18,974**
Copper	**52,665**
Gold	**32**
Lead	**140,020**
Litharge	**25,342**
Mercury	**4,697**
Nickel (reguline)	**35**
Nickel, unrefined (Nickelspeise)	**67**
Nickel and cobalt ores	**5,711**
Silver	**6,797**
Tin	**1,305**
Wolfram (Tungsten) ores	**112**
Zinc	**26,028**

The exports of minerals from Austria are very small. Graphite holds the first place among the objects of export, its productions having more than doubled since 1851, and amounted to nearly 200,000 cwt. in 1860. Considerable quantities of whetstones are likewise exported from Galicia to Russia. Among precious stones, the garnets of Bohemia, and the noble or iridescent opals of Hungary are objects of export; of these, some fine specimens are exhibited, as likewise of the emerald. M. Goldschmidt exhibits a very interesting collection. This consists of a series of emeralds in their matrix, of smoke-topazes (yellowish-brown rock-crystal), and of rock-crystal.

These emeralds are found in the dukedom of Salzburg, in an altitude of 8,700 feet, on a steep cliff, hitherto only accessible by aid of ropes. Fragments of emeralds, found on several occasions in avalanches having rolled down into the neighbouring valley, had led to the discovery of their native locality. This place, having never been made before an object of technical investigation, the exhibitor, in the last days of August, 1861, ventured an excursion to this inaccessible cliff, and, after a search of a few days, was fortunate enough to discover the emerald specimens brought to the Exhibition. He has now purchased from the government the whole of the surrounding surface to an extent of 175 Austrian acres ("joch"), and has opened a regular breaking of emeralds and other minerals, as white and yellowish-brown rock-crystals.

The Chemical Class does not present anything of sufficient novelty to require description. There are some excellent collections containing chemicals of great purity, and there are several displays of pharmaceutical preparations.

Since the adoption of the trade tariff in 1852, the commerce and resources of Austria have materially increased.

Before entering upon a description of the objects exhibited in the Classes III. and IV., a short sketch of the extent and resources of this vast country may prove interesting. The Austrian empire, which embraces an area of about 250,000 English square miles, is, with the exception of Switzerland, the most mountainous state in Europe. Its river system is extensive and affords great facilities for commerce and manufactures, while the former is still more facilitated by the Adriatic and Black Sea.

The great grain producing districts of the Austrian empire are, the Danubian plains of Central Hungary, those along the Vistula, and the Lombardo-Venetian plains along the Po. The latter produce chiefly rice and maize. The average yearly returns of grain are as follows:—

Wheat - - - -	50,000,000	Vienna metzens*
Barley - - - -	50,000,000	,,
Oats - - - - -	100,000,000	,,
Maize - - - -	44,000,000	,,
Rice - - - - -	550,000	cwt.
Buckwheat and Millet -	10,000,000	Vienna metzens
Peas, Beans, Lentils, &c.	5,000,000	,,
Potatoes - - - -	120,000,000	,,

The latter constitute the chief article of food of the inhabitants of the mountainous districts of the northern provinces. They are also extensively manufactured into alcoholic liquors.

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* The Vienna metzen to the English bushel is as 80 to 47.

The export of corn from favourable circumstances exceeds the import, especially as regards the wheat-flour produced by the mechanical mills recently introduced.

The manufacture of beet-root sugar, as in many of the German states, is sufficient for the consumption of the country, therefore but little Colonial sugar is imported. The number of beet-root manufactories—chiefly in Bohemia and Moravia and Hungary, in 1860—amounted to 124. The molasses from these manufactures are used for making alcohol and brandy, of which large quantities are exported; the number of distilleries in 1860 was 103,000, of which about 6,000 deserve the title of manufactories. The yearly consumption of spirits in Austria reaches the enormous amount of 50,000,000 gallons.

Under the Western Gallery of the North-west Transept are samples of the grains produced in the various provinces of Hungary and Bohemia, arranged according to their districts, and above those are coloured photographs of the costumes worn by the peasantry of the latter country, forming a collection of great interest.

In Class III. we find ten sorts of tobacco sent from Hungary. The culture of this important plant might be carried on to much greater advantage were it not for the fact of its being a government monopoly, as well as for the want of fresh capital and enterprise. As it is, however, it forms an important item in the Austrian revenue. In 1860 tobacco was grown over 66,769 Austrian acres of ground in Hungary alone.

The chief tobacco-producing districts of Hungary are the districts of Száthmár, Bihar, Abauj, Szaboles, Heves, Arad, Béchés and Bácá-Bodrog. The produce of Száthmár is represented by Ladislaw Bartha, who sends some fine leaf-tobacco used for the outside coverings of cigars, known by the name of "Theiss-blatt," or "Theiss-leaf." It is remarkable for the fineness of its fibre as well as the size of the leaf (24″ × 18″). Under No. 258 we find several kinds forming part of a collective exhibition. F. Guláisy's tobaccos are of equal quality with the above, but exceed it in size, being (29″ × 22″). The annual produce from this estate varies from 1,500 to 2,000 cwt.

Another excellent quality is exhibited by P. Aczél. It is an improvement on some Latakia seeds brought from America. 500 cwt. are produced annually.

The Countess of Wenkheim and D. Jaszoy contribute samples of a description that, from its beautiful flavour, has been called "Muscatel."

Nic. Szentiványi's tobacco, from the Comitat of Gomor, is considered among the finest produced.

The total produce in 1860 was as follows:—

Snuff - - - - - - - -	60,700 cwt.
Tobacco - - - - - - -	581,700 „
Cigars (inland) - - - - -	69,450,000 dozen.
Cigars made from imported leaves -	1,208,333 „

This quantity, which in favourable years has reached 2,000,000 cwt., was produced by twenty-four state manufactories employing 21,800 persons.

For full details we must refer the visitor to Mr. F. Bárány, who has been intrusted with the entire arrangement of this important Class, and willingly supplies all required information.

The production of olive-oil in the Southern Provinces of the Austrian Empire (Istria, Lombardo-Venetia, and Dalmatia) amounts to a yearly average quantity of about 100,000 cwt.

The culture of another oleaginous plant, the colza (rape), is far more extensive, especially in Hungary and Bohemia; its annual crop giving at least 2,500,000 bushels. A great portion of the crop of lin and hempseed (an average of 2,300,000 bushels yearly) is either exported into foreign parts or expressed for obtaining oil. In 1860, the export of all these three oleaginous seeds amounted to 670,000 cwt. In the same year the home production rose to 500,000 cwt. of rape-seed oil, and 200,000 cwt. of linseed oil. These oils are expressed either in common stamp-mills or in improved mechanical mills.

Besides the 1,000,000 cwt. of tallow produced within the Austrian Empire, large quantities of this material are imported from the Danubian Principalities, to supply the wants of Austrian candle and soap manufactures. In 1860 this importation nearly reached 48,000 cwt. The home production of skins and hides (in 1860, 12,000,000 of ox, sheep, goat, and other skins and hides) is still inadequate to the wants of Austrian industry; so that every year above 100,000 cwt. of this material must be imported from Foreign parts.

Austria produces every year nearly 700,000 cwt. of wool. One half of this quantity is Hungarian; Moravia, Silesia, and Bohemia chiefly producing fine and superfine sorts, the greater part for export. The ordinary qualities are the object of inland industry: inferior sorts are chiefly imported from Foreign parts.

The culture of flax in the mountainous regions of "Riesengebirge," the Sudetes and Carpathian Mountains, and in the Alpine ranges, existed for a long time in its primitive state until quite lately, when the establishment of extensive flax waterings, and the increased demands of mechanical yarn-spinning factories, gave a powerful impulse to the culture of flax, both in quantity and quality. In the eastern and southern parts of the Empire the culture of flax gives place to that of hemp. South-eastern Hungary and the Venetian provinces must be named here as producing this material in superfine quality. The average yearly production, amounting to 2,000,000 cwt. of flax, and to 1,000,000 cwt. of hemp, remains behind the demands of Austria, which still require a supplementary import of these materials.

Silk culture is confined to the Southern and Adriatic provinces of the empire, having reached its highest development in the Venetian provinces and Southern Tyrol. Trials made in the other provinces have hitherto remained without results worthy of note.

The yearly average production of cocoons amounts to 270,000 cwt., of which, in 1860, above 6,000 cwt. were exported to foreign parts.

Vienna has long been celebrated for its meerschaum pipes, and the present display will be interesting to all smokers.

Ph. Beisiegel's case (410) contains some handsome specimens, some of which have stems more than a foot long, made out of several pieces. The amber mouthpieces sent by this exhibitor are also very fine.

E. Schmid contributes a cigar-holder with several full relief figures on horseback. The pleasure of smoking this work of art, must, however, be counterbalanced by the fear of its being injured.

F. Jaburek's full relief copy of Landseer's Midsummer Night's Dream, is a most faithful copy of the well-known original.

J. Wolf (538) contributes very fine copies of the long "straw" pipes, or "cardinals," "churchwardens," &c., in meerschaum.

The Austrian collection of machinery and engineering is small in extent, but contains several novelties which will be briefly noticed. In Class V. the State Railway Company exhibit two locomotives of an entirely novel construction. One of these is an engine for express traffic, having four steam cylinders; the other is a mountain tank engine, on Engerth's principle, having ten wheels 3 feet 6 inches high, all of which are coupled together. The two hinder axles support the tender, and are coupled to those supporting the engine and boiler, by an intermediate axle carried by rods working in spherical bearings on the hinder engine, and front tender axles. All the intermediate bearings for the coupling-rods are made of a spherical shape to allow of lateral motion in passing through curves of small radii. An additional pair of steam-cylinders are placed underneath the boiler, and are used for working the breaks. Engines of this construction are employed on the railway passing through the Norian alps in Austria and Styria. Views of the more important works on this line may be seen in the Austrian photographic department.

Messrs. J. J. Meyer and Son exhibit a drawing of another form of mountain locomotive, with four cylinders, having twelve wheels, which are coupled in two sets of six. Another drawing shows the advantage of this construction, by the small amount of displacement of the axle, produced in passing through sharp curves.

The State Railway Company also show a model of a snow-plough, which is placed in front of the engine, for clearing the line in winter.

Tyres and axles are exhibited by Baron Rothschild, from the iron works at Wittkowitz in Bohemia.

Mr. G. Hubazy exhibits an agricultural steam-engine, arranged for using straw for fuel. The straw is introduced through a funnel-shaped opening in front of the fire-door, and the half-burnt straw is prevented from being carried into the tubes by a grating of rectangular iron bars placed one quarter of an inch apart in front of the tube plate. The half-burnt particles are carried against this grating, which is kept red-hot by the fire, where they are consumed, and only the clear flame is allowed to pass into the tubes.

A small high-pressure turbine, on Jonval's principle, 16¼ inches in diameter, is exhibited by the Janbacher Iron Works.

A model of a large steam-hammer is sent from Baron Rothschild's iron works at Wittkowitz.

The State Railway Company exhibit a drawing of an hydraulic forging machine. This is an ordinary hydraulic press, having a hammer block attached to the large piston: the lifting is effected by the action of the water on a special small piston. The force pumps are driven by a large horizontal steam-engine, the whole arrangements being such as to allow the hammer to be worked at a high speed, like an ordinary steam-hammer.

A model of a flour-mill by Mr. L. Nemelka is deserving of notice, for the exact style of its execution.

Mr. W. Schramm exhibits a new form of Jacquard apparatus for looms, by which a great saving of cards is effected, in preparing the patterns.

In Class X. several models of bridges are exhibited. The suspension bridge over the Danube canal at Vienna, of 274 feet width of span, is remarkable as being the first chain bridge built for railway purposes. The tubular lattice bridges in use on the Hungarian railways are illustrated by a series of photographs.

A floating pile-driving engine is worthy of notice; it resembles the boat mills which are largely used on the Austrian rivers. The pile-driver is erected on a boat, the ram being lifted by a water-wheel driven by the current of the river.

A collection of models of the step-grate furnaces used in boiling down brine, in the Imperial Salt Works at Hall, are worthy of notice, as by their use the commonest and dirtiest fuel may be economised. Specimens of a very inferior quality of brown coal, actually used, are also exhibited.

The representatives of military engineering in Austria are the Imperial Corps of Engineers and Pioneers, together with the technical divisions of the Artillery and Navy, whose members receive their professional education in special establishments.

The raw materials, purchased from private contractors, are worked out by tailors, shoemakers, saddlers, taken out of the different corps of the army, and put at the disposal of these commissions in numbers adequate to the momentary wants. The produced arms, furniture, and linen, are distributed among the regiments and corps. If required, these commissions may furnish, fit for immediate use, a monthly amount of 91,000 complete uniforms, full equipment for 86,000 men and 3,000 horses, and above this, 25,000 complete sets of linen. And it is only in cases of pressing necessity that the trade corporations of large towns are invited to take their share in military arming and equipments.

Gun-barrels, bayonets, and sabres, are manufactured by private industry and delivered to military authorities. The completion of military guns by providing them with fire-locks and stocks is exclusively in the hands of the military workmen of the Imperial Arsenal at Vienna, a new establishment, and one of the grandest amongst technical establishments in general. It is here also that the whole brass artillery of the Army and Navy is cast, bored, and provided with carriages. The casting and fitting out of iron artillery is intrusted to the Imperial Iron works near Mariazell. Projectiles are cast, partly in these iron works, partly in private establishments of the same kind.

The production of gunpowder is a State monopoly. Private powder-mills are provided with their raw materials by the proper military authorities, and are bound to deliver at a fixed price their whole production to the same authorities. From these, other local authorities receive the quantity of powder intended for civil purposes.

The manufacture of sporting arms is entirely in the hands of private industry. A great number of gunmakers, established at Vienna, Prague, and in the other provincial capitals, provide the public with articles of superior quality and great elegance. Similar articles for common use are manufactured at extremely cheap prices by the numerous gunmakers of Ferlach in Carinthia.

About 11,000 persons (besides those employed for the same purpose in military and Government establishments) are employed in the manufacture of military and sporting arms. The value of the articles produced by them may be very moderately estimated at 200,000*l*. for every year.

Maurer Bros. (641), have a fine collection of shooting implements, and military and sporting arms. Among which are breech-loaders on the Lefauché system. The Austrian regulation rifles and bayonets here exhibited will attract attention from military men: they are much shorter and thicker than those used in the English service, the bayonet (sword) being longer and heavier. The sporting rifles used chiefly in the Tyrol, and known as the "Stutzen," are well represented: they are chiefly adapted for short range, and carry a small ball.

The sighting of the sporting rifles is peculiar, and cannot be, as the Enfield, altered according to distance; the average range at which they are used by the Tyrolese being from 100 to 200 yards. The "Couteaux de Chasse," used for stag and wild-boar hunts, are good. Cavalry swords, ranging in price from 17*s.*, are also shown.

The display made in the Class of Naval Architecture is unimportant, there being only three exhibitors. Thirty-seven Austrian dockyards along the shores of the Adriatic supply the number of ships required for the trade in the Mediterranean and Black Sea. Out of 601 vessels, making a total of 9,402 tons burthen, only fifteen, of 4,733 tons, were destined to pass the Straits of Gibraltar.

The construction of vessels for river trade is a separate branch of manufacture, carried on to a great extent in the interior of the country. It is a curious fact, that of the timber-ships trading down the Danube, the greatest number are either sold to Foreign countries or broken up [and sold as timber, only very few being taken up the river again. An average number of only 15,000 workmen are employed in building and fitting sea and river ships, producing an estimated annual value of about 1,500,000*l.*

With the exception of a few opticians of note in Venice, Pesth, Lemberg, Prague, and Gratz, the main production of scientific and philosophical instruments in Austria is in Vienna.

In consequence of the establishment of a large number of practical schools, the manufacture of physical apparatus, which until lately were almost universally imported from Foreign countries, has now been extensively developed.

The number of hands employed in the manufacture of these articles is estimated at 2,000, and the annual production is valued at 300,000*l.* The value of imported instruments is estimated at 40,000*l.*, whereas the value of those exported reaches to the amount of 50,000*l.*

Amongst the most remarkable of the instruments exhibited in this important Class are those of Jos. Kavalier (653), of

Sazawa, in Bohemia. They consist of various implements and apparatus of glass, used for chemical purposes. They are of most excellent quality, and the glass of which they are manufactured is quite free from lead and perfectly pure; another distinguishing feature of these apparatus is their lightness.

J. Leopolder exhibits various instruments, of which the electric telegraphs are the most conspicuous for their good workmanship. His electric railway-signals are most useful, and are employed on many of the Austrian railways, especially in Lombardy, Venice, and Central Italy. They are provided with bells, and are shown in four separate parts, viz., the electro-magnet, an apparatus for interrupting communication, a moving-apparatus, and a roof with the bell.

A good collection of optical instruments, with lenses of flint-glass, varying in diameter up to 16 inches, and smaller ones of Bohemian rock-crystal, is exhibited by J. Waldstein, of Vienna.

There are in Vienna at present no less than four hundred professional photographers, whose chief efforts are employed in producing the "cartes de visite" now so much in vogue; still very fine landscapes and copies of paintings are prepared.

The apparatus used are all made in Vienna, but until very lately the papers and chemical preparations were imported. The number of persons dependent upon this industry is about 2,000, and the value of the articles produced by them about 300,000*l.*

There are three photographers to whose productions we will call particular attention. A. Widter exhibits a most interesting series of photographs from the collection of armour in the Belvedere, near Vienna, originally made by the Archduke Ferdinand, in his château of Ambras, in the Tyrol, and containing armour and weapons, used chiefly by Austrian princes between the fourteenth and eighteenth centuries.

A. Melingo shows a number of views on the Semering Railway; and Voigtlander and Son exhibit a series of large portraits and groups admirably executed.

The manufacture of watches is visibly declining in Austria, owing no doubt to the great competition by Switzerland and other countries. The manufacture of clocks, on the other hand, is advancing, and is carried on chiefly at Vienna, Prague, and Gratz. The component parts of the works are chiefly imported from Switzerland, and put together by the Austrian makers.

The value of clocks and watches annually imported cannot be accurately ascertained; but the amount produced by about 6,000 persons may be estimated at about 75,000*l.*

Schönberger's regulators (691) are among the best; he shows all descriptions, from the eight-day clock to that which does not require winding up for twelve months.

Class XVI. is a Class in which Austria is in every way distinguished. One of, if not the simplest musical instrument is the Jew's-harp, the exports of which from Austria, in 1860, reached the enormous number of six millions. These are chiefly produced by the iron-works of "Stadt Steyer." Stringed and wind instruments are chiefly made at Vienna, Prague, and Königgraz (Bohemia). The population of the barren regions of Bohemia is entirely maintained by the production of the latter.

The seat of the pianoforte manufacturers is Vienna, from whence large numbers are annually exported. The best pianos are exhibited by Beregszy, who shows two pianofortes of speckled Hungarian oak and nut wood, with a new construction of sounding-board; F. Blumel, L. Bösendorfér, and Fred. Ehrbar; the latter shows an upright piano, which for quality of tone is perhaps not surpassed by any other of the kind.

An instrument of which some excellent specimens are shown, is the Cithern. This instrument originally came from the Tyrol, where it is an inmate of nearly every peasant's hut.

The treble or tune is played on four strings stretched over a number of frets, similar to those of the guitar. The note is marked by the fingers of the left hand, while the string is struck by a metal ring worn on the right thumb.

The accompaniment and bass are played on twenty-four gut and metal strings, with the first, second, and third fingers of the right hand. The sound of this instrument is very sweet, but it is chiefly adapted to the "Laendlers," or Tyrolese songs.

The best instruments of this kind are made by A. Kiendl (708), who exhibits four specimens that excel in volume as well as sweetness of tone.

The manufacture of surgical instruments and appliances (as of scientific instruments in general) is almost entirely confined to Vienna and Prague. As inventions specially Austrian, may be quoted Professor Braun's "Decapitation-hook," "Scalariform Repository," and "Colperintor," and Professor Chiari's "Excerebration pincette." Orthopædical apparatus and artificial limbs are manufactured in Vienna, but most objects manufactured of caoutchouc are imported. About 500 workmen are employed in this branch of industry, and their production may be estimated at an average value of 50,000*l.* annually.

The laryngoscopical and rhinoscopical instruments and sections exhibited by Professor Czermak and Dr. Tuerck are instructive. They show laryngoscopic mirrors of various sizes, with all appliances belonging to this branch, as well as several sections illustrative of their methods of examining the larynx and nostrils, &c.

As a novelty worthy of special notice, an apparatus is shown by Professor Dr. Hebra, designed for the use of continuous baths for medical purposes, in use in the General Hospital of Vienna. It consists of a wooden bath 6 feet in length by 3 ft. in width, lined with zinc. An iron frame in the interior supports the ordinary undergirths of a bed, a portion of which moves upon a hinge and may be fixed at any angle, so as to serve as a pillow. This bed is suspended in the bath by bands fixed at both ends, and can be raised or lowered at pleasure. At the upper end, and raised above the bath is a boiler from which the water is supplied by a pipe communicating with the bottom of the bath, the escape-pipe being fixed at the water-level, thus keeping up a constant current which carries off any impurities from the surface. Some small tubes with rose heads are also affixed to the boiler, by means of which the patient's face or any other part of his body may be continually irrigated. The purpose of this apparatus is the continued immersion for any length of time, of patients suffering from diseases of the skin, or from severe wounds caused by fire, and one case is recorded of a patient having thus been kept immersed in a warm bath for 100 days uninterruptedly, and having thus been freed from a supposed incurable disease of the skin.

J. Leiter of Vienna contributes a fine collection of surgical instruments of good workmanship.

Cotton.—The returns for the imports of cotton, which prove a four-fold increase since 1831, show the following cyphers for 1861, viz.:—Raw cotton, 879,500 cwt.; cotton yarn, 182,700 cwt. There are 170 cotton manufactories at work throughout the empire, mostly employing water-power. One of these, situate at Haralitz in Northern Bohemia, is accounted the largest establishment of this kind on the Continent.

Cotton-weaving (as well as linen-weaving) is still practised extensively as a domestic branch of industry in the valleys of the "Erz," and "Riesen-Gebirge," where, however, it is in a very backward state for want of the modern improvements in the loom. The power-loom may be said to have been introduced since 1851, since which period 15,000 of them have been set to work.

The exports of cotton manufactures in 1860 are stated at a value of 800,000*l.*, home demand being entirely covered by inland manufacture, which gives employment to about 350,000 persons, whose annual productions are estimated at 12,000,000*l.*

Amongst the exhibitors of cotton yarn and weavings, attention may be called to the Pottendorf Chartered Cotton-spinning and Weaving Mills in Lower Austria. This establishment, the first founded in Austria, owes its existence to Prince Jos. Schwartzenburg and Prince Colloredo-Mannsfeld, who in 1801 engaged an eminent Lancashire engineer for the purpose of designing plans for the construction of the works, which were subsequently carried out in 1803.

Linen.—In the Eastern Provinces flax is grown in considerable quantity on the slopes of the Carpathian Mountains. The landowner, after reaping the plant, rets and brakes the fibre, spins the yarn, and, during the winter months, works it up into coarse linen for his own use. In the higher regions of these mountains, however, (in Upper Hungary and Galicia,) flax is the principal produce of the soil. Here every house has its loom, and as the production of linen exceeds the household consumption of that material in these districts, large quantities of coarse webs find their way into other parts of the empire. The larger manufactories are exclusively confined to the Western provinces.

Machine flax-yarn spinning is to be met with in Bohemia, Moravia, and Silesia, where 33 establishments are employed in this species of manufacture, and from whence come the finer qualities of linen and damask. The exports of linen in 1860 are valued at 960,000*l.*

In the east and south of the empire, flax is partially giving way to the culture of hemp, which is worked up principally for domestic consumption, a small quantity being used in the manufacture of ropes, sailcloth, &c.

Raymann and Regenhart are large exhibitors of linen of various kinds, and make a fine display of table-cloth manufactures.

Silk.—From 250,000 to 300,000 cwt. of cocoons are produced by inland silk-worm breeding, which is generally united to an establishment for raw-silk spinning; 83 such establishments are now at work on an extensive scale, producing upwards of 20,000 cwt. of raw silk, of which nearly one-half is exported.

The manufacture of silk tissues is almost entirely confined to Vienna, and its environs, South Tyrol, Venetia, and Bohemia having but few manufactories of this material.

The number of hands employed in this branch of industry may be stated at 100,000, their annual productions being estimated at a value of 2,500,000*l*,

Silk is exhibited in every stage of manufacture, from the cocoon upwards, and is a highly interesting study, of which to speak at more length our space will not permit.

The collection of silk furniture stuffs shown by P. Haas and Sons is worthy of attention; it contains a large display of specimens, amongst which are some fine table-covers.

The collective exhibition of the Viennese silk-stuff manufacturers is an attractive show of great variety, with specimens of excellent quality.

The annual production of wool averages about 700,000 cwt. of which about one-fourth is exported. In the eastern provinces woollen manufactures, of a rough kind, are made by the peasants. Cloth manufacture is, however, almost entirely concentrated within the districts of Reichenberg, Brulem, Iglau, and Bielitz. This branch of manufacture gives employment to upwards of 400,000 hands, the yearly productions being valued at 14 millions of pounds.

Our limited space does not allow of our dwelling upon the individual exhibitors in this Class, of which there is a large number, and many of whom show very fine specimens, to which we must therefore refer the reader.

Carpets of a common description, and horse-cloths, &c., are manufactured in the north-west of Hungary, and table-covers of low quality are produced in the Tyrol, and exported from thence by the inhabitants of the Pusterthal. Vienna has one large manufactory, and a small number of similar establishments exist in Upper and Lower Austria and near Reichenberg (Bohemia). This class is of minor importance in Austria, and no great show is made, there being but three exhibitors.

Dyeing and printing is almost exclusively practised by special manufactories, centred around Vienna, Prague, Pesth, and Reichenberg, excepting in Vorarlberg, where some of the weaving establishments print their own goods. The same may be said in regard to silks, with this difference, that silk dyeing and printing is limited to Vienna and its immediate neighbourhood. Sewing and knitting silk is dyed at Verona. Woollen and mixed wares are nearly all dyed and printed in the weaving manufactories of Bohemia.

Lace.—The manufacture of lace embraces but a small portion of Austrian industry. It has existed, however, since the sixteenth century in the more elevated plains of the Bohemian "Erzgebirge." In consequence of the introduction of the bobbin-net frame in this branch of industry in 1831, which previously gave employment to 60,000 hands, manual labour has since been almost entirely restricted to the use of the lowest qualities of cotton-thread, thus greatly reducing the number of hands required, and at times subjecting the labouring classes in these districts to great want. Since then many of the female inhabitants in the Western districts of the Bohemian "Erzgebirge" have taken to embroidery. A few manufactories exist also in Vorarlberg.

Some handsome Cashmere shawls with Indian embroidery are contributed by F. Nowotny of Vienna, and S. Szovathy exhibits some attractive specimens of the Hungarian "Guba," or cloak, part of the national costume, richly embroidered.

The general use of furs for clothing is confined to the Eastern provinces; in the western parts of the empire they are used almost exclusively for the manufacture of articles of female winter-clothing. The Hungarians and Transylvanians are generally clad in sheep and lamb-skins.

The manufacture of brushes is of small importance. It is only lately that the manufacture and tanning of leather has become of importance in the western provinces of Austria. With the exception of the Russian-leather manufacturers of Galicia and Upper Hungary, whose products find their way to all parts of the empire, the tanners are universally confined to operating upon inland hides for local consumption. The home-produce is below the requirements of the population, and large quantities of skins and hides are therefore imported from foreign countries, especially from South America.

The manufacture of saddlery, &c., in Vienna (the only town of which this can be said), greatly exceeds the local demand, and this description of goods is therefore partially carried to the neighbouring eastern states. The production of leather fancy-goods has, during the last few years, gained a conspicuous place among the branches of industry practised in Vienna. Somewhere about 150,000 persons are employed in the above classes of manufacture, the annual productions of which are valued at near 8,000,000*l*. Amongst the great variety of objects exhibited in this Class, attention may be called to the interesting collection of sporting utensils, such as powder-flasks, shot-pouches, and so forth, contributed by Maurer Bros. of Vienna (under Dome), which are of good workmanship, and of general good quality, and amongst which are many practical inventions.

It is only since the introduction of sewing-machines that the manufacture of linen wearing-apparel has given rise to the more extensive establishments now in activity in some of the larger towns, and the same may be said in respect to the manufacture of clothes, boots, and shoes. In consequence of this change, a considerable export of articles of clothing to Turkey and the Danubian provinces has commenced within the last few years.

Vienna and Prague are the only towns in which the manufacture of gloves, umbrellas, &c., has gained any importance, supplying the entire inland demand. The number of persons finding employment in these branches of manufacture is stated to be 350,000.

This Class embraces a large number of exhibitors, amongst whose goods we find a variety of every sort of clothing, boots, shoes, &c.; to enter into the details of which would take up too much of our limited space. We must therefore be content to call special attention to the very handsome Hungarian costumes shown by C. Raczkovics, and M. Jambor.

Rags being the only article (raw silk excepted) upon which a high export duty is raised by the government—amounting, by-the-way, to nearly nine shillings per cwt.,—but an insignificant quantity of them leave the country, and they are used in the manufacture of paper, which is widely spread over the empire. Manual labour in this branch of manufacture has latterly been almost entirely superseded in the western provinces, by the more profitable mechanical processes now in use; but it is still employed in the eastern provinces. The number of mechanical paper manufactories at present is forty-five, some of which have three engines at work, and the number of paper-mills is two hundred and two. The rapid development of paper manufacture by machinery has been of importance in improving the relations of Austria to other countries, as shown by the fact that 95,000 cwt. of paper were exported in 1861, whereas merely 21,000 cwt. were imported.

Steel pens are an exclusive feature of Vienna manufacture. Nearly 40,000 gross of them are produced annually, which is inadequate to the wants of inland consumers. The demand for lead-pencils, ink, and other working materials is fully satisfied by inland manufacture.

Nearly 350 printing and 150 lithographic establishments, employing 1500 hand-presses, and 400 mechanical presses, are in constant activity. In the western provinces there is scarcely any place of 5000 inhabitants without a printing establishment, but in the eastern provinces these are generally confined to the capitals and larger towns.

Bookbinding has made considerable progress in Vienna, Prague, Pesth, and Venice, where it is practised on a large scale. In other parts of the empire it has, however, remained below the general standard, in consequence of its being in the hands of individual tradesmen, united into corporations. Nearly 150,000 persons find employment in the above branches, whose annual produce represents an average value of some millions of pounds sterling.

A. Nabenicht makes a fine display in ornamental bookbinding, the most attractive specimen of which is a large book of the German Empire, bound in stamped leather, with a representation of the Archangel Michael in relief, surrounded by the armorial bearings, in colours, of the Electors of Germany. An interesting selection of illustrated works, amongst which a collection of coloured prints of rare plants is conspicuous, and coloured oil-prints on linen, such as landscapes, &c., is contributed by A. Harsinger and Son. Specimens of bookbinding, of superior workmanship, consisting of ledgers, account-books, and albums, are shown by C. L. Posner of Pesth. Rollinger Brothers' album of enormous size, presented by them to the Corporation of London, is a remarkable piece of workmanship. It is bound in red morocco leather, richly ornamented with gilt plates and wreaths of flowers in mosaic, of variously-coloured leather. Some excellent lithographs are shown by Reiffenstein and Roesch, one of which is well known, and represents the Emperor of Austria in the costume of a chamois hunter. F. Paterno exhibits albums of coloured lithographs, containing scenes from the Alps, Austrian national costumes, &c. A set of well-executed woodcuts representing scenes from Kinkel's celebrated poem of "Otto der Schutz" (designs by Schwoboda), are exhibited by R. Von Waldheim, and some good specimens of chromo-typography are displayed by L. and C. Zamarski.

F. Leidesdorf and Co., Lorenz and Sons, and Smith and Mergnier, show good assortments of paper of various sizes, quality, and colours, and of comparatively cheap prices; and a fine collection of black-lead pencils of superior quality, and of pliant artificial slates, is exhibited by L. Hardmuth and Co. It may be interesting to know that their establishment has existed since 1797, when a Mr. Jos. Hardmuth made the invention of adapting the Bohemian graphite to the manufacture of lead-pencils. Since then their manufactory has steadily increased, and in 1861 upwards of twelve millions of pencils were produced, a large number of which were exported to Russia, Germany, and America.

Educational works are exhibited by Austria in great quantity and of excellent quality; in the latter quality the maps exhibited by the Military Geographical Society (1172) excel. The results of the expedition of the Imperial vessel "Novarra" are also published, and will prove of great interest.

It would lead too far to enter into a detailed account of the many objects here shown, which might of themselves fill a book. The visitor is therefore referred to the Austrian Catalogue, where a detailed description is given.

The house furniture used in the eastern provinces is chiefly manufactured by the house owners themselves, and is limited to a table, some chairs, and a chest for clothes, the latter frequently ornamented with designs in colours.

The prevalent way of decorating the inside of rooms is by painting, wherefore paper-hangings are but little in request: Prague, Vienna, Salzburg, and Innsbruck, have, however, some manufactories of the latter.

A handsome oratory, in the mediæval style, belonging to the Archduchess Sophia, carved by Leistler (the exhibitor of the well-known carved bedstead of 1851), and with paintings by Professor Kupelwieser, is exhibited by Professor Roesner.

The most attractive piece of carving in this Class, is a palisander-wood cabinet, exhibited by Schoenthaler of Vienna; it is ornamented with admirable carvings in box-wood, designed after Kaulbach's illustrations of "Reinecke Fuchs" (Reynard the Fox), that celebrated satire of the middle ages.

Thonet Bros., of Vienna, contribute a number of articles of furniture, remarkable for their lightness and durability. They are of wood, bent by means of a patent process, so that the back and two legs of a chair can be made in one piece. The back and seat are so contrived as to allow of their being unscrewed for packing, and the absence of glued joints renders this species of furniture advantageous for use in hot climates. The manufacture of this furniture was commenced in 1850, and since then has greatly increased.

Joseph Wilde, a joiner of Zircs, an obscure village in Hungary, exhibits two chiffoniers inlaid with a variety of kinds of wood, made by himself and entirely by hand. The minutest details are carried out with great care.

A most attractive part of this Class is the fine display of furniture made by J. von Mannstein of Vienna (see Class XXXVI., Kh). It consists of chiffoniers, a sideboard, tables, bedsteads, easy-chairs, couches, &c., all so constructed as to fold and pack up into an incredibly small space; some are so ingeniously arranged as to form their own packing-cases. Amongst others, are two moderately-sized mahogany wardrobes, so contrived, that a complete set, consisting of a table, sofa, two easy and six common chairs, may with great facility and without risk of damage be packed up in them. These wardrobes have double sides, which, when turned inside out, transform them into a couple of strong packing-chests, with edges lined with iron for protection. Another most ingenious device is a bedstead which, from two feet in length (fit for a child), can be extended so as to form a bedstead of six feet by three. A nutwood buffet is also worthy of remark for its excellent workmanship: it is seven feet and a half high and the same in width, with glass front, and so cleverly contrived as to fold up and form a packing-case of three feet by four.

This "disjointing furniture" is extensively used by most of the Austrian Government employés, military men, &c., who are liable to frequent change of residence.

The exhibitor undertakes to furnish an entire house with this kind of furniture, and every other article required, such as plate, crockery, &c., all of which may be packed together and fitted into a van contrived by him for the purpose of easy transport to any distance by land: a model of this van may be seen with Mr. Mannstein's furniture.

Among the fine display of articles made by Maurer, Bros., of Vienna, under the Western Dome, and which in the Catalogue have been included in Class II. (see 641), not the least remarkable is a set of buckhorn furniture, consisting of a sofa, table, chairs, candelabras, &c. Besides being tastefully executed, the fact of the buckhorn being neither coloured nor varnished, is a proof that none but the very best antlers have been used, colouring being frequently made a cover for defects.

The once extensive production of nails by hand-work, as it still exists at Zbirow (Bohemia), Losenstein (Upper Austria), and Kropp (Carniolia) is now evidently losing ground before

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the increased demands for nails and pins produced by machinery. Latterly the manufacture of fire-proof safes begun in Austria since 1852, and of kitchen-implements of cast or plate iron has considerably advanced. Vienna is the exclusive seat of these branches of commerce, whilst the production of enamelled cast-iron cooking vessels belongs to the iron works in Bohemia, Moravia, and Hungary.

The blacksmiths, locksmiths, spur-makers, tinkers, &c., are spread over the whole area of the Austrian Empire. These branches of iron industry employ nearly 40,000 persons, and the value of their annual productions amounts, in a round sum, to twenty millions of Austrian florins.

Next to iron articles, those made of copper hold a conspicuous place in Austrian industry. While the insufficient production of raw copper requires an importation (26,000 cwt. in 1861) for supplying the wants of inland industry, hammered copper in the shape of plane and concave plates and objects for immediate use, made of this metal, are the objects of an important foreign trade, especially with Turkey. The same is the case with zinc. This metal must also be imported in a raw or half-worked condition, to supply the demands of home industry.

Iron and metal industry (including the numbers mentioned above) give employment to more than 70,000 persons, their productions being valued at fifty million florins per annum.

More than one half (140,000 cwt.) of the total quantity of steel of every sort, manufactured in the Austrian Empire, is worked up by inland industry. Deduction being made for the quantities of this raw material, used for the production of machines or worked out into scythes, sickles, armoury, musical and surgical instruments, a yearly amount of about 45,000 cwt. remains for cutlery.

The valley of the river Enns, offering means of transport for the steel production of the Innerberg Mining Company, and those of its affluents, Erlaf and Ybbs, lying partly in Upper, partly in Lower Austria, include a group of establishments for the manufacture of iron articles. The centres of these industrial regions are Waidhofen on the Ybbs and Scheibbs for Lower, and Steyer and Kirchdorf for Upper Austria.

The different sorts of iron and steel articles (razors, knives, scissors, awls, drawing-knives, &c.), are made by workmen united into corporations, distinct from each other and never encroaching upon the speciality of any of its fellow-corporations.

Above half a million dozens of table knives and forks, 50,000 dozens of razors, thirty millions of awls, come every year out of these workshops, in good quality and at extremely moderate prices, being sold within the empire or exported to the neighbouring eastern countries.

Refined cutlery, such as razors, pen-knives, table-knives and forks, &c., are manufactured in great quantities by the cutlers of Vienna, Prague, and other large towns. A circumstance deserving special notice, is, that latterly Tungsten has come into extensive use for the production of smiths' tools, under the patent of M. Jacobs.

In Austria, the manufacture of steel and cutlery employs nearly 25,000 hands, and produces articles representing an annual value of 1,200,000*l*.

In Class XXXI. there are but few makers of importance. We may mention M. Winckler and W. Siedan, who show good specimens of letters for sign-boards; those of the former are cast iron, and adapted for exposure to the air; those of the latter are stamped and more fit for in-door use.

Bartelmus and Co. (1225) make a good display of cooking-utensils of enamelled iron plate. This enamel is described as good and almost indestructible, while it contains no hurtful mineral.

Marky and Co., and A. Pleischl, also contribute considerable collections of the above which are remarkable for lightness.

F. Eder and Count F. Harrach have sent some tin-plate and iron, and copper wires which are deserving of attention.

In Class XXXII. we have to notice some important collections of edge-tools. Foremost among these are those sent by

F. Wersheim, comprising three sets, viz., carpenters', turners', and tanners' tools. Among others this exhibitor sends a small carpenter's bench which will plane, saw, and bore with the greatest ease. It can be used for nearly every kind of work, and is particularly useful in the construction of models. There are two saws, one of which, a circular saw, will cut at any required angle. The whole is worked by the foot of the workman.

The tools exhibited by J. Weiss will surprise many by the very low prices. He professes to supply a full-sized carpenter's bench, 6 feet long, complete for the sum of 19*s.* 6*d.*, a moulding-plane for 1*s.* 6*d.*, and a box of tools for 33*s.*

The collective exhibition made by the town of Steyer comprises all kinds of cutlery, but is chiefly remarkable for its scythes. Of the quality of the latter visitors can convince themselves by hacking at a sheet of iron-tin placed upright, and which these scythes will cut without receiving the slightest mark.

Steyer has for several centuries been known for its cutlery, in the manufacture of which from 12,000 to 15,000 persons are employed.

The largest quantity of gold and silver is used by the imperial mints of Vienna, Kremnitz in Hungary, Carlsberg in Transylvania, and Venice. The coinage in 1861 shows a return of 26,200,000 of silver coins, value about 2,150,000*l.* sterling; 700,000 gold coins, in value about 940,000*l.* sterling; 1,000,000 of small silver coins, in value about 10,000*l.* sterling; 185,000,000 of copper coins, in value about 240,000*l.* sterling. The manufacture of articles in gold and silver is of most importance at Vienna, Venice, and Prague. The former of these places alone has nearly six hundred establishments producing these articles, some of which have increased to the importance of large manufactories; and leaf gold, leaf silver, gold and silver wire, lace, cord, &c., are not extensively produced in any other place. The export of articles in precious metals is but small, with the exception of lace and cord, &c., which find their way to the East.

The Bohemian and Tyrolese garnets, and Hungarian opals, are the only kind of precious stones found in the empire. The former are cut and polished in various parts of Bohemia, the latter in Vienna.

Imitation rubies, emeralds, sapphires, &c., are made in a high degree of perfection near Gablonz.

Bolzani and Co. contribute a number of specimens of gold chains and watch-guards (under Dome).

A silver-gilt tankard, about 13 inches in height, and weighing 9½ marks, the property of Prince Colloredo Mansfeld, is exhibited by Jos. Glanz. It is decorated with eight allegorical figures in relief, representing the various branches of the Trade Union, and was designed by Professor C. Rösner, and S. Fuehrich.

A handsome massive gold bracelet, tastefully set with a ruby and pearls, having a novel mechanism to prevent its being lost, is shown by J. G. Poppe.

D. Egger exhibits a sword and belt, with several sets of buttons, &c., set with precious stones, made for a Hungarian nobleman, price 250*l*.

Some fine specimens of jewellery, in diamonds and other precious stones, forming diadems, &c., are shown by F. Kobeck and the Leonic manufactory at Stans in the Tyrol.

Count Schoenborn has contributed an interesting collection of garnets from his estates in Bohemia, valuable for their deep colour and superior hardness ; and W. Bubenicek, A. Schmidt, and H. Grohmann are the principal exhibitors of jewellery with garnets.

The rise and progress of glass manufacture in Austria dates from the beginning of the last century, and was materially promoted by letters patent granted by the Empress Maria Theresa to the then emigrant glass-makers. The extensive forests of the Bohemian and the Biesen Gebirge became, in consequence of their stores of pure quartz, the principal homesteads of the newly-established glass manufactories. In process of time these spread southward and westward to the Alps and Carpathian Mountains, so that all the provinces of the empire now more or less participate in this branch of industry. Though wood is still principally used as fuel inthe manufacture of glass, coals and peat have of late been introduced. The empire has two hundred and fifteen glass works, annually producing 650,000 cwt. of glass, and giving employment to 60,000 hands. The annual produce is valued at 1,837,500*l.*, one half of which falls to the share of Bohemia. The quantity of glass imported is so small as to be scarcely worth mentioning; whereas the exports are now more than double what they were twenty years since, amounting in 1861 to upwards of 320,000 cwt.

J. and L. Lobmayr are amongst the largest exhibitors in flint glass. They have some fine chandeliers and candelabra in the mediæval style of pure white glass; also a pair of fine chandeliers in the rococo style of pure cut glass, with gilt bronze; and a pair of very handsome chandeliers, painted and gilt, in imitation of Sèvres porcelain, fitted up with gilt bronze. Besides these, their collection contains a vast number of every kind of article of glass manufacture.

J. Mayer's Nephews have, amongst a variety of articles, a pair of flower vases of cut glass, green, with rich gilding and paintings.

J. H. Adams and Co. show a handsome "cheval" mirror, of large size, in the rococo style, and glass stand.

Besides the above, a great variety of most attractive objects are shown in this branch, which our space does not allow of our mentioning.

Pottery is well represented in this collection, forming, as it does, an important industry in Austria.

Brick and tile kilns are spread over all parts of the empire, but are erected to a larger extent in the neighbourhood of populous towns like Vienna, Pesth, Prague, &c.

Terra-cotta wares (building ornaments, statues, &c.) are produced in three manufactories, belonging to the districts of the Commercial Boards at Vienna and Salzburg, to the amount of 60,000 cwt. yearly.

The production of common pottery for household use, and of clay stoves (from 850,000 to 900,000 cwt.) occupies about 8500 potters in all parts of the empire.

Fire-bricks are produced partly in stoneware and porcelain manufactories, chamotte-stone being employed.

Melting-pots for glass-works are produced in these establishments of fire-proof clay, and under their own management.

The production of stoneware and Wedgewood occupies fifty-four manufactories with one hundred and eight ovens, amounting from 35,000 to 40,000 cwt. yearly; one half of which falls to the share of Bohemia, where ten manufactories of greater extent are active, at the same time also producing porcelain.

The porcelain manufacture is centred in a group for the most part associated round about Carlsbad, where kaolin, felspar, and quartz are found of superior quality, and fuel (brown coal) is to be had at moderate prices. This group numbers ten manufactories with thirty-six ovens. Besides these there are porcelain manufactories at Prague and Tannowa (in Bohemia), at Vienna, and Berend, and Telkibanya (in Hungary). The total production reaches annually the quantity of more than 30,000 cwt.

The total value of yearly production in the above-named branches of earthenware industry in Austria is computed at nearly 30,000,000 florins. The number of hands employed therein amounts to 60,000 men, women, and children.

The finest articles exhibited are from the Imperial Royal Porcelain Manufactory of the State at Vienna.

The present exhibition of 964 pieces will prove that the Imperial Royal Porcelain Manufactory is devoted, not solely to one particular branch of production, but comprehends, within the large province of that industry, the manifold application of porcelain as objects of its pursuit. The Imperial Royal Manufactory of Porcelain was established in 1718, and is, after that of Meissen (erected in 1710), the oldest in Europe. The raw materials are, with the exception of Passau china-clay, taken from inland products.

There are consumed per annum—

	Cwt.
China-clay - - - -	1,564
Quartz - - - - -	559
Felspar - - - - -	282
Gypsum - - - - -	199
Marble - - - - -	80
Fire-proof clay for saggars -	14,481

Of fuel, the porcelain kilns being heated with wood, the wants are: soft wood, 2172 cords (72 cubic feet each), coal and coke, 1516 cwt.

The object of this manufacture is hard porcelain with felspar glazing. The usual class is not generally subject to warping, therefore articles with long straight lines, and also large flat surfaces like picture-plates, &c., are to be executed. Many objects, which must be very thin, are cast, for instance: crucibles, evaporating vessels, tubes for laboratories, &c., &c. Ornaments are produced with handwork or print. The latter comprises gold and colour printing, according to a process peculiar to the Imperial Royal Manufactory, joining an economical to the technical advantage. Its application was brought to bear in the execution of large orders, especially a great table service for 500 persons. The production of one year (1861) amounts, of porcelain, to 277,230 pieces, which, finished for sale, together with the fire-proof bricks formed of used-up saggars, reach the value of 94,700 florins.

The articles coming under this Class are almost solely manufactured in Vienna, and give employment to about 5000 persons, the annual production of whose labour is estimated at 400,000*l*. sterling.

Amongst the large display made by Brent and Rosenberg (under Western Dome), the objects most worthy of attention are a large-sized Bible and album of carved wood, ornamented with porcelain and bronze.

An interesting display is made by Nieber and Breiter, whose manufactory is one of the largest, and who exhibit dressing-cases, portfolios, albums, and a variety of other objects, beginning at low prices, and gradually rising to the standard of the articles more exclusively shown by other exhibitors.

The collections of A. Klein, Roden Bros., and C. Girardet (all under Western Dome), are remarkable for good taste and finish.

C. Stenzel has some good things in the shape of tea-caddies, purses, &c., of wood, carved in imitation of leather; and F. Therger has contributed an attractive collection of albums, card-cases, paper-knives, cabinets, &c., of a novel description, being made of wood, carved, inlaid and otherwise ornamented with Austrian marble and "sprudelstein" of various colours. Of these a large album and table-top may be pointed out as most worthy of attention.

ZOLLVEREIN.

Number of Exhibitors, 2875.

The South-western Transept and Galleries, with a portion of the space under the main Picture Gallery, have been allotted to the Zollverein States, and the free towns Hamburg, Bremen, and Lübeck, which latter, with the Duchy of Mecklenburg, exhibit under the South-western Gallery.

Class I. of the Zollverein's exhibition displays the mining and metallurgical products of all the countries belonging to it; but by far the greatest portion of the specimens exhibited belong to Prussia, nearly three quarters of the collection being occupied by the products, which belong to two rich provinces of that kingdom, namely, Rhenish Prussia and Westphalia. The owners of mines and smelting works of these provinces have united themselves to contribute a complete collection, and the specimens are collected and selected by Dr. Wedding, under the chief direction of Mr. Von Dechen, at Bonn.

Maps are placed at the walls, which will facilitate the study of the collection, showing the geological features of whole counties and single districts, coal-basins, &c.

Besides Prussia, Nassau and Hesse have contributed collections which can lay claim to completeness, the former of which is to be found on the south-eastern part of the principal case, and the other in the centre before the large copper caldrons.

In the adjoining room there is to be noticed the column of rock salt from Staplehurst, and the tables of salt, containing products of salt works, minerals, &c., in the centre of the northern part. Millstones, wrought iron, larger and smaller pieces of freestones, &c., fill the other places.

A special catalogue giving not only an enumeration of the specimens, but also a description of the conditions of occurrences will give information more detailed for every one who is interested in mining and metallurgical matters.

The various States forming the Zollverein are well represented in the Western Annex; the larger number of the articles exhibited are furnished by the kingdoms of Prussia and Saxony.

In Class V. two locomotives are exhibited—one is by Mr. A. Borsig, of Berlin, and the other by Mr. G. Hartmann, of Chemnitz; the latter is on Crampton's principle, having the cylinders placed near the centre of the boiler, with two pairs of coupled driving wheels, 4 feet 6 inches in diameter. The leading axle is moulded on a central pivot bolt or "bogie." Engines of this pattern are in use on the railways in the mountainous districts of Saxony, on lines having slopes as high as 1 in 40, and curves of a minimum radius of 275 feet.

The railway carriages made by the Railway Plant Manufacturing Company, of Berlin, for the Berlin and Stettin Railway, are deserving of the highest commendation. The compound first and second class carriage is divided into compartments, which are united together in pairs by means of an internal door. The end coupé is set apart for a second-class smoking compartment. The second-class seats are furnished with well-stuffed cushions, covered with grey cloth, and are almost identical with the first-class carriages of other European countries; the first-class is fitted with blue damask, with luxurious spring cushions, in a manner equal to the best private carriages. The third-class carriage is similar in arrangement to those in use on many English lines.

Small four-wheeled trucks for mineral traffic are exhibited by the Sieg Rhenish Iron Company.

Iron and cast-steel tires, wheels, axles, &c., are exhibited by Krupp and Co., the Saxon Cast-Steel Company, the Bochum Steel Company, and others. Krupp and Co. also exhibit enormous masses of cast steel, including a double crank shaft for a screw steamer, weighing 9 tons; a single paddle-wheel crank shaft, in the state of a rough forging, weighing 16 tons; various guns, the largest of which is 8 inches in diameter and weighing 9 tons in a finished state; a block of cast steel of 20 tons, broke through to show the fracture; and a series of patent weldless tires of the pattern used by different railway companies, the largest being 8 feet in diameter.

The Bochum Cast-Steel Company make tires up to 9¾ feet in diameter; they also send a cast-steel bell weighing 11 tons. A pair of steel rollers, made by the Saxon Cast-Steel Company, are fine specimens of polishing.

In Class VII. the principal portion of the display is furnished by Mr. R. Hartmann, and Mr. G. Zimmermann, both of Chemnitz, in Saxony, the "Manchester of Germany." The first-named exhibitor sends a series of screwing and shaping machines, for making bolts and nuts, a slotting machine, a drilling machine that can be used for drilling round holes or slots, a radial drill, &c. Mr. Zimmermann contributes a large planing machine, capable of taking work 20 feet long by 6½ feet wide, a number of other machine tools for engineers' use, and a complete set of wood working machines, including a band saw, roller planing machine, mortising, moulding, and other machines, the whole of which will be found at the top of the eastern avenue of the Western Annex.

A machine for cutting bottle corks is exhibited by Gartner and Co. Three circular knitting-frames are sent from Wurtemberg, by Fouquet and Co., of Stuttgart.

Mr. L. Schwartzkopf, of Berlin, exhibits a small steam hammer, in which the anvil is formed by the ram of an hydraulic press, like that of Imray and Copeland in the English department.

Mr. C. Heckmann, of Berlin, exhibits a large copper vacuum pan, measuring 10 feet in diameter, by 12 feet in height; this is one of the largest of the articles in the Zollverein department, and is placed opposite to Krupp's steel case.

Mr. Schlickeysen exhibits a continuous brick making machine with vertical pug mill, capable of making 15,000 to 20,000 bricks daily. The moulded bricks from the cutting-frame are lifted by an endless chain elevator, to the drying platform placed at a higher level.

The machinery in motion is driven by two horizontal engines on Carliss' system, in which the steam cylinder is placed on one side of the rectangular framing, an arrangement which allows the amount of foundations to be reduced to a minimum. The distribution of the steam is effected, by separate admission and exhaust valves at each end of the cylinder, instead of by the slide valve usually employed.

Mr. Hartmann exhibits a horizontal condensing engine of 20 horse-power, and Mr. Egells, a double cylinder beam engine, on Woolf's principle.

Messrs. Henschel and Son's high-pressure boiler is formed of a number of large tubes made of wrought-iron plates, from 15 to 20 feet long, and 6 to 12 inches diameter, which are inclined at an angle of 24°. The fire-grate is placed at the upper end, the feed water is introduced at the lower end. A steam chest is used to collect the steam from the tubular generators. A full-sized tube forming part of the body of a boiler on this system is exhibited; it has been proved at a pressure of 450 lbs. to the square inch.

Mr. Langen's smoke-consuming fire-grate is constructed on a principle which has been found to be of great practical value. It is formed of two inclined, and one horizontal set of bars, and a perforated plate; each grate is also furnished with a dead plate, and is separated from the one below it by an opening 3½ inches high, through which the fuel is introduced. When in use, the grates are covered with burning coal, and the fresh fuel is placed on the dead plates in front; in firing, the burning fuel on the lower or horizontal grate is pushed over on to the perforated plate, the fresh coal taking its place; the contents of the middle grate are then pushed over the incline, and are spread out over the fresh coals: the same process is repeated with the contents of the top grate. In this manner the bars are always covered with fresh and cold fuel, which tends to preserve them, and the upper layer of clear burning coke causes the gases rising from the distillation of the coal to be perfectly consumed.

Mr. Bialon's group of machines is worthy of notice, as being the only representative of calico-printing machinery in the Exhibition. It includes a cylinder drying machine, a machine for printing in four colours from engraved rollers, a block printing machine for two colours, a double pantograph for engraving the rollers, and a calendaring machine.

Two large models of railway bridges are exhibited in the Zollverein department. The principal one is the bridge over the Vistula at Dirschau, in Prussia, which is constructed on the lattice principle, united by cross girders at the top and bottom into a rectangular tube, through which the roadway passes. There are six spans, each of 397½ feet in length, between the piers.

The second model is that of the bridge over the Rhine near Mainz, built by Klett and Co. of Nürnberg. This is a double bow truss, similar to Saltash Bridge, but having the arched parts of the trusses made of plates of wrought iron, instead of using an elliptical tube, and chains. This bridge crosses the river at an angle of 63° to the course of the stream, and has four principal spans of 332 feet opening, and thirty-eight minor land arches, varying from 49 to 110 feet span.

A model of an inclined plane for lifting canal boats, employed on the Elbing canal, in eastern Prussia, is placed close to the model of the Vistula Bridge. The lifting power is furnished by an overshot water-wheel. Four of these inclines are in use with a lift, varying from 67 to 80 feet each.

PRUSSIA.

In the display of the minerals and machinery, all the States of the Zollverein have been included. As far as the other classes are concerned, it appears necessary to state the general character of the collections from each State.

The chemicals from the kingdom of Prussia are not remarkable for any peculiarity. There are some exceedingly good chemical products, a great number of very fine colours, especially ultramarine. Paraffin and mineral oils, with amber and preparations from amber, have several exhibitors. Eau de Cologne and essential oils are conspicuous.

Substances used as food and wines are numerous: animal and vegetable substances used in the arts make a nice display, but there is nothing requiring any special explanation. The machinery has been described. There are a few exhibitors of arms, a rifled piece of ordnance of cast steel, and rifle barrels of cast steel in different states of manufacture.

Krupp has some pieces of ordnance, needle fire-arms, a double barrel gun on Lefancheux's system, and some other examples are exhibited.

Gustavus Laute exhibits a fine collection of side arms.

Naval architecture is limited to a propeller shaft and screw.

There are some well-made philosophical instruments, such as galvanic batteries, microscopes, polariscopes, and balances.

Photography and photographic apparatus; horology and musical instruments, find each a few representatives; and there are seven exhibitors of surgical instruments.

Amongst the collections illustrating the textile fabrics of all kinds, which show almost every degree of excellence, there is nothing requiring description.

Paper, stationery, printing, and bookbinding Class is one well worthy of close examination. Papers of great excellence are exhibited. Printing is displayed of a high character, and much of the binding is tasteful. The educational works and appliances show the degree of attention which is paid in Prussia to the cultivation of the mind.

Furniture is shown in a variety of forms.

The Berlin Royal Prussian Iron Foundry exhibit many very fine examples of iron castings.

Herrmann Gladenbeck exhibits a good zinc casting of a horseman fighting with a lion, electroplated with bronze, and a colossal bust of Schiller, after Dannecker's original, executed in bronze.

The galvanized zinc castings exhibited by Geiss are very fine specimens.

The iron and hardware manufactures do not present any novelty. Many things show much care in manufacture, and are generally well designed.

In the collection of works in the precious metals, we find a beautiful shield in frosted silver with arms inlaid in enamel, a present from the nobility of the Rhenish provinces to their Royal Highnesses the Prince and Princess Royal of Prussia; also wedding presents from the twenty-seven departments of Hessia. Vollgold and Son exhibit the present of the city of Berlin to their Royal Highnesses.

Glass is well represented, many of the productions being excellent in quality, and artistic in design.

Pottery is mainly represented by the Berlin Royal Porcelain Manufactory. The vases and decorating vessels are numerous. Three Urbino vases with views of Potsdam are very fine. The wine-coolers with children, after Rubens, are beautifully painted.

The Wiemar vases with Watteau groups, and the Florence service after Benvenuto are exceedingly fine. The pictures on porcelain are exquisitely painted, and the works in biscuit are carefully executed. Amongst the general collection will be found many productions which show a high state of manufacture and a considerable amount of artistic taste.

The exhibition of amber is remarkable. One piece of amber exhibited by Perlbach of Dantzic, is rare in size, form, and colour; it weighs 12 lbs., and is valued at 600*l*. The manufacture of amber is one of the specialities of the country, and hence the beautiful and complete collection shown.

The Duchy of Anhalt-Bernburg exhibits only food and wines.

The Duchy of Anhalt-Dessau-Cöthen has a small collection in fifteen classes, but nothing remarkable.

THE GRAND DUCHY OF BADEN.

This Court is principally occupied by a display of jewellery from the manufactories of Pforzheim. It is of small value, the gold not being above 14 carats. Its principal recommendation is cheapness and lightness of design. Above the cases of jewellery is a display of Black Forest clocks, also remarkable for their cheapness: some are handsomely carved.

In the part of this Court under the Gallery is a display of cigars and tobacco. Some of these are made of the tobacco grown in the Grand Duchy, and others have an outside leaf of Havannah tobacco. Next to these comes a fine looking-glass from the establishment of the Mannheim branch of the St. Gobein factory. Next to these are a case of leather, and some furniture.

On a wall in the Würtemberg Court is a collection of clocks and parts of works by the company for the manufacture of clocks at Lenzkirch.

BAVARIA

Occupies the western portion of the Transept which is here divided between it and Würtemberg. It consists of three small divisions, the first of which contains a display of hops, for which Bavaria is celebrated, some basket-work, and chemical colours.

The next division has tinted papers from Aschaffenburg; a display of drawing-pencils, and two drawings showing their quality. The most remarkable thing in this division is a case containing impressions of seals (*i. e.* coats of arms), cut by Birnbeck, of Munich. This case, upon examination, will be found to be well worthy of notice from the exactitude and sharpness of the impressions. There are also some toys in papier-mâché, a display of coloured pencils, and some mathematical instruments.

The next division again has coloured pencils, with which some samples of drawing are displayed over the stand in elaborately-carved and gilt frames. Then comes a stand of toys, among which is a piece of carving in ivory, representing a hunting scene; this is well deserving of notice, much care and labour having been bestowed on the carving of the various figures of men, horses, dogs, and deer, which are scattered all through the woods.

Some painting on china, and a stand of Faber's pencils, occupy the walls of the next division; while a stand of cut glass forms an object of attraction in the centre. This completes the Bavarian show exhibition.

The Duchy of Brunswick has but a small collection, in which paper, printing, &c., occupies the prominent place.

Frankfort on the Maine sends chemicals, food, philosophical instruments, textile fabrics, and a few examples of jewellery.

The Kingdom of Hanover exhibits some iron ore and coal, a few good chemicals, vermicelli, tobacco and snuff, some wines, a considerable collection of india-rubber manufactures, and in each of the more important classes we find one or two exhibitors.

The Electorate of Hessia has but a small collection. Limmerman exhibits some of his already well-known iron, zinc, and bronze castings. The precious metals are represented by some beautiful snuff-boxes, an assortment of crosses, and some good jewellery.

The Grand Duchy of Hesse shows some good chemicals, a fair collection of foods, some excellent wines and good cigars. Textile fabrics and clothing form an important portion of their exhibition. The furniture class is large, and many of the manufactures good.

The Principality of Lippe shows Cremnitz white, starches, linen thread, and tobacco-pipes.

The Grand Duchy of Luxembourg, in addition to copper ore, antimony, and alabaster, has a ruling-machine, a good collection of gloves, and a few other unimportant articles.

The Duchy of Nassau is mainly represented by minerals and wines.

The Grand Duchy of Oldenburg shows "lighting stones," strong beer, corks, some bobbins, a musket, a saddle, and a model of Heidelberg Castle.

The Kingdom of Saxony makes a good display of chemical preparations, some vegetable and animal products, machinery already described, watches, muric, a considerable collection of woven goods, some excellent examples of printing, and good maps.

The Royal Saxon China manufactory exhibit some manufactures worthy of the high reputation of these well-known works.

The Grand Duchy of Saxony exhibits some woollen goods, and a few ornamental goods.

The Duchy of Saxe-Attenburg send to the Exhibition potassium, a cross-bow, some woollen goods, a few brushes, some kid gioves, and a book-case.

The Duchy of Saxe-Coburg-Gotha has an exhibition of much the same character.

The Duchy of Saxe-Meiningen has some encaustic colours. Toilet soaps, wools, calf-skins, dolls of papier-mâché, some iron manufactures, a little glass, and some nice examples of pottery.

The principalities of *Schwartzburg-Rudolstadt*, of *Schwartzburg-Sandershausen*, and of *Waldeck*, have but little, and nothing requiring a remark.

The Kingdom of Würtemburg has a small division in the Transept, and a little space under the Gallery. It is divided into several compartments like Bavaria, in the first of which, from the Dome, are some wines, knives, and some cases of plate. Some wood-engravings are deserving of notice: photographic albums, and a few more cases of jewellery complete the second division, while the third contains clocks, toys, and hardware.

MECKLENBURG-SCHWERIN.

Number of Exhibitors, 78.

SITUATION IN BUILDING.—*South-west Transept, and South-west Transept Gallery.*

Vegetable products and food are exemplified in wheat, rye, peas, and oats—smoked goose-breast and cheese. There is one exhibitor of liqueurs and one of medical and other soaps. Wool of good quality is shown by six exhibitors. There is a curious carriage with swan's neck without axle, beam, or box-seat; a machine for cutting angles, and almonds; a hook plough; pasteboard impregnated with asphalte; a few rifles, a spirit gauge, and a reflecting circle. One photographer rejoices in "ambrotypes," one in horology; and we have a pianino. Textile fabrics are few. Boots and bookbinding find three exhibitors. A jewel-press, a walnut table, parquet floors, and a folding door illustrate furniture. Glass paintings, a life-buoy, travelling stockings, and lucifer matches complete the display.

HANSE TOWNS.

Number of Exhibitors.—Bremen, 36; Hamburg, 134; Lubeck, 13.

SITUATION IN BUILDING.—*South-west Transept.*

As these States have a separate space allotted to them, we will take them according to groupes. The most important display is made by Hamburg, which occupies the space nearest the West Dome. The first object of attraction is a statue of Arminius, sheathing his sword after his great defeat of the Romans. This statue is admirably executed, and is of gutta-percha, prepared to resist weather and climate, a plan that may prove useful for garden and hall ornaments.

Opposite this is a display of silver plate by Wilkens and Sons (31), among which may be noticed a wild boar defending himself against a pack of hounds. Immediately below this are a number of works in amber, for which Hamburg workmen have earned some fame; they consist of bracelets and a necklace, and are beautifully carved. This is also the case with a number of drinking cups and some statuettes. A candle screen is particularly beautiful. Four landscapes exquisitely carved are placed against a background of mother-of-pearl, which imitates the tints of an evening sky. The grand display made by this town consists of a quantity of buckhorn furniture by Rampendahl. It is made of antlers carefully selected and combined with great taste. Stuffed heads of various game are introduced as ornaments with great effect. There is a considerable quantity of furniture which would occupy too much space to describe.

To smokers, a case of cigarettes made with paper prepared from the fibre of the tobacco plant will prove interesting.

Further on we find a display of boudoir furniture and lace by Forquignon (26), of Bremen, most tastefully arranged.

Agricultural implements are shown, but they are of little importance. A pair of folding doors of oak are richly carved and well made.

Prepared leathers are exhibited in some quantities, as well as liqueurs, chocolates, and soaps. Naval architecture is not so well represented as might have been expected, but there are some few models, and some ropes of good quality. Bird-cages appear to be an article of commerce, large quantities being exhibited. The display of philosophical instruments is small and not very important.

GREECE.

Number of Exhibitors, 280.

Situation in Building.—*Near the Horticultural Gardens, North-west Court.*

Since the days of antiquity Greece has been more the land of poetry and of heroic deeds than commerce and industry. Nevertheless it makes a creditable show of native manufactures, besides sculpture and paintings, some of which represent scenes from the last and successful struggle for independence from Turkish rule. Among the sculpture is a representation of Kodros, a chief who received his death-wound in the thick of the battle where he precipitated himself, it having been said by the oracle that Greece would not gain its independence until he was killed. He is represented mortally wounded, and in the act of raising the cloak which had concealed his features. Among a variety of sculpture in Pentelicon marble, are busts of Jupiter and of Homer, which are worthy of special attention.

There is a small collection of minerals, of which the most noteworthy are some fine specimens of chromate of iron, and a few specimens of Greek marble, including good samples of red marble from Laconia. Here may be mentioned two pillars of the beautiful verde antique marble from Tinos, two round tables, and a very handsome chimneypiece of the same material, exhibited by Cleanthes of Athens.

Some good samples of wheat and barley are shown, together with Indian corn of fine quality, and specimens of Grecian tobacco grown in different parts of the country, which show that agriculture is not neglected. Preserved (dried) fruits are also exhibited, such as figs, &c., as well as various kinds of oil, amongst which the olive oil is remarkable for its clearness and fine colour. There is a full display of Greek wines, both red and white, most of which are as yet very little known in England, but some of which are of exquisite flavour. We find, also, fair samples of cotton and wool, and an interesting collection of various kinds of timber.

A display of photographs shows that Greece is as far advanced as any other country in this branch of industry, at the same time forming an interesting collection of views of the celebrated ruins of ancient Greek architecture. Amongst them may be mentioned views of the Temple of Minerva at Sunium, of the Theatre of Herodes Atticus, and of Jupiter Olympius at Athens. There are also a number of coloured photographs illustrative of the highly picturesque modern Greek costume.

Silk manufacture has long been an important branch of Greek industry, and we observe, besides fine samples of cocoons, and of rough silk, some very fair specimens of silk stuffs, mostly used in the manufacture of female wearing apparel. Bareges of extremely fine texture are shown, dyed in every variety of colouring.

One of the most prominent features in the Greek Court is the embroidery in gold and silver, of which there are numerous specimens, well worthy of attention. They consist mostly of articles of wearing apparel belonging to the Greek national costume, male and female. A table-cover of lilac velvet, most richly and tastefully embroidered with gold and silver, and a gold fringe, attracts much attention—is exhibited by A. Andreon, and T. Zenou of Athens.

We observe, also, specimens of furriery, such as mantles, &c., and articles of clothing, consisting of national head-dresses, boots, sandals, &c., some of which are skilfully embroidered.

Amongst some specimens of wood-carving there is one especially worthy of notice. It is a representation of "The coming of our Lord," carved in box-wood, by Agathangelos of Athens, and is executed with such skill and attention to the minutest detail, as to be equal even to the exquisite carvings of the Hindoos.

There are many more articles in this Court quite worthy of attention, but which, unfortunately, our space will not allow of describing more particularly.

HAYTI.

SITUATION IN BUILDING.—*North Courts, British Side.*

Hayti has contributed little of importance, with the exception of some excellent cotton, and a magnificent block of mahogany. The latter is chiefly used in the manufacture of furniture, some of which is here shown. Some bowls of this wood, as well as lignum vitæ, deserve attention. A number of curious earthenware vessels used by the natives are also shown, resembling a common tea-pot in shape. The ropes made of fibres, and the saddlery are good, but few in quantity. The agricultural produce consists of sugar, beans, &c., while the produce of the mines is represented by iron ores, coal, copper, and rock crystal. These, with some embroidery of small importance, complete this display.

ITALY.

Number of Exhibitors, 1344.

SITUATION IN BUILDING.—*At the corner of the Nave and Central Avenue, extending to the Cromwell Road Entrance, adjoining France.*

The mineral produce of Italy is well represented.

The iron manufactures of the country, which are rising in importance, are well represented. The magnificent ores from Elba are especially deserving attention.

Lead, which is found in Piedmont, Lombardy, Modena, Tuscany, Calabria, Sicily, and Sardinia, is fully displayed.

Copper.—This ore is exhibited from Volterra, Pomorana, from the vicinity of the Lago Maggiore, and from the Ollomont mines, near Turin, &c.

Sulphur.—There are fourteen exhibitors of sulphur, one of the most important minerals of Italy. Upwards of a quarter of a million tons are annually raised in Sicily and the Romagna.

Messrs. Guerra deserve peculiar notice for their turned marble fountains and balustrades, as also for the ingenious manner in which they bore marble cylinders without waste of material.

Of the chemical and pharmaceutical preparations, little need be said; one thing appears, if real, as somewhat curious. F. Tovo, of Turin, exhibits "coral reduced to the state of mucilage, and capable of being coloured and moulded."

There is a good exhibition of boracic acid from the lagoons of Tuscany by the heirs of Count Lardarel, who commenced the works; and Henry Duval has established artificial boron-soffioni by means of artesian wells near Monterotondo.

The agricultural produce exhibited from Italy exhibits great excellence of quality.

Olive oil is very largely exhibited, and of the highest class.

The wines of Sicily are contributed largely, in fine condition, and good quality. Piedmontese wines are well spoken of, as are also those of Sardinia and Asti. Several good samples of tobacco are in the collection.

The woods, especially the cork-wood, deserve attention; hemp is well displayed, and cotton in considerable quantities.

Cotton has been cultivated in Southern Italy from time immemorial, and was probably introduced by the Saracens, in the 9th century. We have historical evidence that as early as the 11th century it formed one of the principal agricultural products of Sicily and of the provinces on the shores of the Adriatic and Ionian Seas. G. B. della Porta, a writer of the 16th century, states that in his time it was extensively cultivated in the Puglie, "*apud Appulos.....ubi copiosissime seritur.*" Documents of the year 1050 exist at Bisceglia, *Terra di Bari*, by which some priests of Adueno let their church tenures for the cultivation of cotton, "*ad colendum gossypium.*" In the last century the cultivation extended as far north as the provinces of Sienna and Grosseto, in Tuscany. During the wars of Napoleon I. and the Continental blockade, the Italian mainland supplied almost the whole of Europe with cotton; it was especially grown around Naples, being generally known in commerce under the name of *Castellamare cotton.*

The quantity of cotton now grown in Italy is quite insignificant, even where most cultivated. In the province of Terra di Otranto, only 700 or 800 tons are produced annually, and 140 in that of Terra di Bari. Both in Southern and Central Italy, as before mentioned, large tracts of country would be suited to the growth of cotton, were they only drained; indeed, it might easily be made one of the staple products of Italy, without in the least degree interfering with the present agriculture. All that district along the Ionian Sea, once Magna Grecia, is now depopulated, and the neighbouring inhabitants cannot settle there from want of drainage, which has never been attended to from that very ancient period of Italian civilization. To give an idea of the extent of land that might be thus turned to account, it may be stated that upwards of 8,000 square kilometres, now lying waste, might be cultivated with cotton in the southern continental provinces alone. Of these 8,000 kilometres, or 800,000 hectares, if only one-third were cultivated annually with cotton, there would be a produce of 100,000 tons, or about 550,000 bales.

There are several good collections of madder, garancine, wood, &c. The essential oils are of great excellence.

The mechanical arts do not receive any large contributions from Italy.

The principal objects in the Italian collection are, a six-wheeled goods engine from Naples, and a model of a so-called "Funicular locomotive," or carriage furnished with drums over which a rope passes, and a set of powerful breaks, which is intended for drawing trains up slopes, where ordinary locomotives cannot be used. The necessary motive power is intended to be obtained from a water-wheel. There are several drawings showing the application of inclined planes with this kind of traction in the railways in the valleys of the Alps. A set of photographs from drawings, of the rock-boring machine of Mr. Sommellier, which is employed in driving the tunnel through Mont Cenis, is to be found in front of the locomotive from Naples.

Examples of Mr. Grimaldi's rotatory steam boiler are exhibited in the Italian department: it is also to be seen in the Eastern Annex.

The manufacturing machines exhibited are chiefly in connection with silk spinning and weaving. Messrs. Guppy and Pattison send an apparatus for winding silk from the cocoons; and a portable apparatus for the same purpose is exhibited by Mr. J. Battaglia.

Bonelli's loom has already been mentioned at page 252, Vol. I. The principle of this invention is as follows: the warp threads are divided by means of needles, worked by electro-magnets, the lifters being attached to small rods or pistons, which form the armatures of a series of parallel electro-magnets. The Jacquard card is replaced by an endless band of paper, covered with metallic foil, on which the pattern is painted in a non-conducting resinous varnish. A fine metallic comb forms part of the circuit of the conducting-wires, the teeth being constantly pressed against the pattern, and at each shift of the latter the magnets connected with such of the teeth as are in contact with the metallic surface become temporarily active, and draw back their pistons, while the teeth resting on the varnished ground of the pattern are out of the circuit.

The same system of combs pressing on an intermittent conducting surface is exemplified in the printing apparatus of Mr. Bonelli's telegraph. In this apparatus the messages are set up in ordinary metal type, in a single line, which is made to pass slowly under a comb of fixed metal points, which just touch the printing face of the type. The receiving apparatus consists of a table, bearing a slip of paper, moistened with a solution of nitrate of manganese, which is made to pass under a comb exactly similar to that of the type-frame. It will be easily understood that the current can only pass through the points, when they are in contact with the face of the type, and in this way an exact fac-simile of the letters is obtained, by the decomposing action of the current on the moistened paper; the result being a message printed off in brown characters, which is due to the production of hydrated peroxide of manganese from the nitrate of manganese employed.

In the class devoted to objects for construction, civil engineering, &c., we have some admirable specimens of artificial marble, exhibited by the Marquis de Campana; some specimens of this will be found in the Nave.

The cadastral surveys in Sardinia, by A. Robbini, are of a high character.

The metaphoric manganesioferous jasper, from Beverone, near Spezia, with the hydraulic cement made from it, is of great interest.

The military engineering of Italy is fairly represented, but there is nothing demanding notice.

There are a few interesting philosophical instruments, some photographs, and a little music.

Cotton has been already named. Silk is, of course, largely exhibited, and the beauty of much of it will at once command attention.

The textile fabrics generally do not require notice.

The paper, printing, and educational classes should be carefully examined.

Marqueterie tables, Florentine mosaics, and other similar works, are of exceeding beauty. The following must be especially noted:—The Florence Royal Manufactory, in Peitre-Dure, exhibits some exquisitely manufactured tables. A. Monteneri has a series of Marqueterie views of Rome, Venice, Florence, and Naples, showing most delicate workmanship. G. Lancetti has an ebony table and casket inlaid with woods with great taste. But this class of work is so well known that we have only to indicate that it is to be found in the Central Avenue.

The iron and hardware presents no remarkable points.

The coral ornaments, the specimens of archæological jewels, the lava work, and the electrotype imitations of ancient shields, are highly interesting. The engravings on coloured glass, the artificial aventurine and calcedony are curious. There are many good imitations of majolica and Lucca della Robbia ware.

JAPAN.

Number of Exhibitors, 11.

SITUATION IN BUILDING.—*Adjoining China, near the Entrance to the Horticultural Gardens.*

The specimens of the rice-glass have excited some attention. This appears to differ in no important respect from ordinary soda or potash glass. It is made from sand obtained from the washing of the rice, and the husk obtained in clearing it. These husks are peculiarly rich in silica, and have only to be combined by heat with a due proportion of potash to become a fine vitrified substance. A gelatinous preparation of rice solidified is also exhibited.

The lacquered ware is peculiar in many respects, and of much interest. The porcelain is, much of it, very beautiful; the carvings in ivory and wood of an exquisite character. The following are curious illustrations of a very remarkable people:—

Specimens of minerals, copper in bar, lead ore, and stone for sharpening tools, from Hakodadi; lava from Fusiyama, coal from Fezin.

A collection of Japanese gold, silver, and copper coins.

A large collection of specimens of Japanese paper used for a great variety of purposes, and manufactured in imitation of leather, &c., also paper money.

A collection of manufactured articles in silk, crape, cotton, tapestry, and Kowoo bark, and a cable of human hair.

Specimens in carving of ivory and wood; illustrated books and maps; lithochrome printing, illustrating Japanese manners, costumes, &c.; figures of a native artist; story-books in the Hirakana character, &c.

A Japanese Encyclopædia, illustrated works on natural history, &c., on chemistry, and a list of public officers; a quadrant and sun-dial, a compass, a pedometer, a clock, a thermometer, and a telescope.

An interesting collection of toys, and models illustrating costumes, &c.

Commodore Lord John Hay exhibits a collection of silks.

The collection, containing specimens of every description of silk that can be obtained in Japan, was made up by Her Majesty's Consul at Kanagawa (Captain H. Vyse) and Lord John Hay. They were assisted by that well-known and very greatly respected gentleman, Mons. Jaquemont, of Yokohama, who has been for some time past engaged in the silk trade with Japan, where his industry, intelligence, and probity in all his dealings are thoroughly appreciated. Of the great varieties of silk in Japan, the larger proportion have never been permitted to reach the European market; and any one conversant with the subject will observe, in a glance at the specimens, that five or six of the best qualities of silk have never before appeared in England. This restriction upon the export of the better qualities of the raw silk, no doubt arises from the action of the government of Japan, always most jealous of foreigners and of any increase to the foreign trade; but it is gratifying to find that the supply of these better qualities, although at present limited, could, under more liberal government in trade, be indefinitely increased.

Captain Howard Vyse observes, in reference to the silk trade, that "Twenty-one provinces produce silk. Eight or ten other provinces might be added, but their production is of too little importance to be noted.

"All the provinces between the east and north produce silk. Aussion and Montsen alone represent 45,000 bales, about 22,500 piculs of annual production. In comparing the total production of Japan (which is about 67,500 piculs) with the principal silk countries of Europe, before the malady among the silkworms broke out, we find, according to documents in our possession, that the production of France was 2,000,000 kilograms, of Italy 4,000,000 kilograms, of Spain 300,000; that is to say, that Japan produces as much as Italy and Spain put together (4,300,000 kilograms), and as much again as France.

"The export for the season 1861 and 1862 will not exceed, it appears, 8,000 piculs, but there is a promise of a great extension when affairs in Europe return to their normal state, when the Daimois no longer oppose the best kind of silk being exported, and especially if in exchange for the port of Neeagata other ports be opened in the same district."

LIBERIA.

SITUATION IN BUILDING.—*Northern Courts, under the Stairs near the Horticultural Gardens.*

The Republic of Liberia—numbering some 500,000 souls, of whom about 484,000 are aboriginal inhabitants of the country, &c., about 16,000 Americo-Liberians—was founded some forty years ago, on the west coast of Africa. Situated on that part of the coast of Guinea (most fertile in rice), called the Grain Coast, with the San Pedro River for its south-eastern boundary, Liberia has great advantages of climate, of soil, and of variety of productions. Every species of tropical produce thrives in this country. Rice is abundant, and is cultivated on the high lands as well as on the low grounds near the coast. Indian corn, sweet potatoes, cassava root, beans, peas, water-melons, pine-apples, oranges, lemons, afford ample supplies for the demands of commerce, and for the consumption of the inhabitants. The articles exported are, coffee, sugar, cotton, ginger, pepper, indigo, ground nuts, arrowroot, palm-oil, ivory, camwood, and other woods for dyeing, as well as for building purposes. Nearly all these productions are indigenous. The wild coffee tree, the same species as that ordinarily found in other countries, may frequently be met with in the woods. Those parts of the country situate on the borders of the St. John, Junk, St. Paul, and Cavallay rivers are the most fertile, the people upon the Junk and St. Paul being more given to the cultivation of sugar, whilst those upon the St. John cultivate coffee. Cotton grows equally well all over Liberia, and being of good quality is undoubtedly destined to become a great staple of export.

The principal materials for building are wood, stone, and brick. The forests abound in suitable timber for houses, but stone or bricks are usually preferred, though more expensive, on account of the "bugabug," a destructive insect, which infests wooden houses. There is plenty of excellent blue and grey granite, and hard sandstone, as well as clay suitable for bricks; and lime is obtained from the shells of oysters, clams, and snails.

Iron ore is found in great quantities all over the country, and is used in the manufacture of agricultural implements, cutlery, and arms; but with the exception of some gold and indications of coal, no other minerals have as yet been discovered.

The revenue of the republic for 1861 was 149,550 dollars, whilst the expenditure was 142,831 dollars.

Amongst the collection of highly interesting objects exhibited, are a number of fibres and articles manufactured from them. A bundle of fibre from the trunk of the bamboo tree (1) is taken from the external coating of the tree, and makes cordage of great strength, of which nooses are made for the snares used for taking wild animals. The fibre from the leaf of the bamboo tree (2) is applied by the natives to the manufacture of many articles, such as bags, necklaces, caps, mats, &c. The fibre of the palm-tree (3) is taken from the leaf. The fibre of the leaf of the pine-apple (4). African hemp (6) grows wild near the sea-shore, and may be collected in any quantity.

We find also specimens of timber, such as black gum from the high land. Burwood, which is found mostly on high land, and grows to a height of 60 or 70 feet, and 3 or 4 feet breadth across the stem; and of the cedar, which is very abundant, growing on swampy land.

Cotton is exhibited in several varieties, among which is the kidney seed, or Brazilian cotton.

There are samples of two distinct kinds of coffee, and also of the coffee berry unhulled.

Sugar, which grows luxuriantly in Liberia, is another of the important objects shown; and there is a collection of various kinds of oils made from the palm, palm-nut, palm-kernel, the pea-nut, and the cocoa-nut.

Amongst a number of miscellaneous objects, we observe a very fine elephant's tusk, a variety of native manufactures of textile fabrics, a numerous display of implements for agricultural purposes, such as hoes, bill-hooks, whips, as well as cutlery, consisting of knives, war-spears, swords, &c., and a number of others.

MADAGASCAR.

SITUATION IN BUILDING.—*North Courts, British Side.*

The Mauritius Government exhibit packets of gums, specimens of unwrought iron, iron ore, and blocks of wood.

Lieut.-Col. Middleton sends an iron chair, presented by His Majesty King Radama II., a spear, a collection of spoons, and two musical instruments.

E. Mellish exhibits specimens of spades, knives, and tools; horn spoons, shoes, stockings, and silk lambas.

F. Bedingfeld a spear, and a cotton lamba.

J. Caldwell a collection of tools, a mat, Rafia cloth and cord, and a cotton lamba.

The Rev. — Ellis, lambas for different purposes; matting, boxes, cloth, &c. made from the rafia palm; an iron lamp; and J. Morris a native straw box, containing five others.

The London Missionary Society contribute brass scales for weighing money, iron and silver weights (the latter made from dollars); silver ore, native ornaments, &c. of silver and beads; baskets made from a reed, grass for basket-work; a pair of shoes, two wooden dishes, a sword and scabbard, knives, a walking-stick, an amulet of beads, and a branch of the rafia palm, with a cone.

THE NETHERLANDS.

Number of Exhibitors, with the Dutch Colonies, 452.

SITUATION IN BUILDING.—*The North-west Courts.*

The display made by Holland is in every way worthy of the ancient commercial fame of the country. Foremost in importance is the "Star of the South," a brilliant, weighing 125 carats, exhibited by Messrs. Coster, who own some of the largest diamond mills in Amsterdam. The "Star of the South" is oval in shape, and its colour, what is technically known as "pink-white," in distinction to "white-white," the colour of the Koh-i-noor.

In the same case are a number of diamonds, of all sizes, illustrating the various stages of the cutting. This art-cutting is confined almost exclusively to Amsterdam, where not less than 10,000 persons are said to be dependent upon it. After the diamond has received a certain polish the facets are cut upon it by pressure on a horizontal plate, revolving at the rate of about a mile per minute. As no mechanical aid can be brought to bear upon this process, and it is left entirely to the skill of the workman, it will be obvious that great dexterity and experience are required. The difficulty of this process will be clearly understood by any person attempting to cut a potato into a figure of eight equal sides.

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Near the "Star of the South" is some silver plate, chiefly interesting from its bearing a national feature.

Owing to the humidity of the Dutch climate, and the exhalations from the many canals, all metal is apt to get tarnished, and require frequent cleaning, wherefore smooth surfaces are preferred to much ornament.

Three large glasses, by D. H. de Castro, engraved by hand, with diamond, are well deserving of attention.

The centre of the Dutch Court bears the sober character of the people. Woollen blankets are displayed in large quantity, and in unrivalled quality. This branch of manufacture is a speciality of Leyden.

Damasks are also well represented.

Chocolates and spices are of considerable importance as articles of export, as are also cigars, which are exhibited in superior quality.

The furniture is of elegant design, and at very moderate prices, as an instance of which we may notice a handsome looking-glass, costing only 14*l*.

Inlaid woods are very fairly imitated in paint.

Some gold ornaments, worn by the Dutch peasants, are also curious. Formerly it was the custom of every Dutch woman to convert all her property into ornaments for the head and dress, probably on account of the wars which long distracted the Netherlands, when it was of importance to be able to hide property on very short notice.

Dr. J. A. Van Eyk has contributed some highly interesting photographic reproductions of etchings by Rembrandt (194). The originals form part of a valuable collection in the Royal Museum at Amsterdam, valued at 10,000*l*., and have not before this been reproduced. This gentleman has also constructed a thermometer (178) for the purpose of demonstrating to schools or assemblies the action of the atmosphere. It is constructed like the face of a clock, with the degrees of centigrade marked in a semicircle. The hand is moved by a thread, to which is attached a leaden weight resting on quicksilver.

A chronometer, with secondary compensation (182), deserves attention. It was found that the ordinary chronometer, in use in the navy, varied in its accuracy as it approached the tropics or poles, according to the variation of the temperature. By the secondary compensation principle this is to a very great extent obviated.

A specimen of the compasses now in use in the Royal Dutch navy is also exhibited. The face of the compass floats on alcohol of 150 per cent., contained in a case with an elastic bottom, to allow for the expansion and contraction of the spirit under the influence of heat and cold. The object of the alcohol is to give the face a steady motion when the ship is rolling in a heavy sea. (See Class XII.)

The carriages exhibited by Holland are also good, and especial notice is due to two very handsome carpets, exhibited on the western wall of this Court.

Surgical instruments are well represented, as well as the liqueurs for which Holland has long been famous.

The Dutch colonies are represented by a case containing some filigree-work from Java, and some native figures in stone.

NORWAY.

Number of Exhibitors, 219.

Situation in Building.—*North-west Courts, and North-west Gallery.*

The exhibition made by Norway is in many respects one of great interest. Immediately opposite the entrance to the Court it has a trophy, in which the most striking object is an anchor manufactured at the Royal Dockyard of Horten. It weighs 3 tons, 9 cwt. 2 qrs. 15 lbs., and is destined for the new steam frigate "Kong Sverre." By this stands a fine granite column, made in the prison at Christiania; a model of a pilot lugger, a freestone font, some coils of rope, and lastly a sledge, covered by the skin of a bear, killed after a fortnight's hunt, and being wounded five times. At the entrance of the Court is a stand of the arms made at the Royal Factories of

Kongesberg, and used in the Norwegian army. Immediately opposite these, on the left side, are some inventions which are deserving of especial notice. They are exhibited by Ch. Steenstrup (213). The first of these is a self-acting harpoon for killing seals. These animals have certain rocks to which they always resort, and which can be recognized by the marks left by generations of them. Having discovered one of these rocks, the inventor of this harpoon bores a hole like those made for blasting in mines, and inserts a brass tube containing a strong spiral spring. The latter is pressed down and the harpoon (a steel bolt) inserted and covered by a metal cap, with a hole large enough to allow the harpoon, which is attached to a wire-rope, to pass out. The animal, to get on the rock, first places its fins upon it, and then draws its body up. From the position of the machine it thereby presses its chest against the cap, which immediately frees the spring, and the harpoon is forced into the animal. Another invention of his, and one that may prove of great use on board ship, is a moveable jet piece for fire-engines. In case of a fire in the hold of a vessel, where it is dangerous for a man to approach, this jet-piece can be placed on a pole and approached to the seat of the fire; the nozzle can then be turned, by means of a chain, so as to send the jet of water in any required direction. In front of these are a number of models of pilot and fishing boats: we will notice one of the former from the south-west coast. These luggers and their hardy crews have long been known to merchant vessels trading to those parts. They are simple of construction, and have no bulwarks. The cabins are forward, and the vessel worked from a kind of box sunk in the deck in front of the tiller, and where the men retire in rough weather. In spite of their sailing qualities, and the boldness of their crews, numbers of these are annually lost.

An article of great commercial importance for Norway is its cod-liver oil, some highly refined specimens of which are exhibited by P. Möller, the inventor of a new process for refining it. Many attempts have been made to destroy the nauseous smell peculiar to this oil, by means of lime and caustic kali; but these substances have the effect of still more decomposing the oil and rendering the smell stronger.

The process invented by this exhibitor consists of melting the liver in a kettle suspended over boiling water, the steam from which causes the liver to melt without overheating the oil. While this is being done the whole mass must be stirred with large wooden spoons. By these means he has succeeded in obtaining a purer oil than hitherto produced, while his apparatus may be easily transported to the shore nearest the fisheries—an important object.

The show of machinery from Norway and Sweden is small in extent, and is almost entirely confined to steam-engines and machine tools for working iron.

Mr. A. W. Frestadnis exhibits an engine for a light-draught gun-boat, on Woolf's principle, in which the larger cylinder is made of annular shape, the smaller one being placed in the centre. This plan of construction is similar to that adopted in the large Cornish pumping-engines that were employed in draining the Haarlem Lake.

Mr. Scheutz exhibits a small rotatory engine, with a drawing of a small screw-boat, in which it has been applied.

Lund's ball press, used in making bullets for the Norwegian army, is exhibited by the Aker Works, Christiania.

Mr. Holmgrew exhibits a model of a direct-acting blowing engine, with three cylinders, to be driven by water-power.

Mr. Guilafsson's machine for making nails is of a novel construction, and is exhibited in action.

The most attractive display in the Norwegian Court is that of wood and ivory carving, and silver ornaments. The wood carving is by T. Fladmoë, of Christiania, and contains, among some pieces of minor importance, a drinking cup, which merits particular attention. It is carved with great precision and accuracy, and, like all the ornamentation done by the peasantry of this country, is copied from old Scandinavian models.

In the same case are various objects carved in ivory by Ole

Olsen Glosimodt. Glosimodt, who was born in the parish of Silejord, for many years confined his talent to making such trifling ornaments, cups, boxes, &c., as are usually made by the peasants. At the age of thirty he came to Christiania, and his works having attracted notice, he was sent, through the assistance of some friends, to the school of the Art Union at Copenhagen. Here he long supported himself by the sale of his works, and frequently returned to his native place to visit his old parents. Having at length attracted the attention of the government he received a pension, and was sent to Rome, at the public expense, to study the art of sculpture. He is his own smith and carpenter, and all his designs are worked out with a small file and a knife (such as shown in this case). His best productions are, a reduced copy of a gigantic statue by Thorwaldsen of Christian IV., in the cathedral of Roskilde, the ancient capital of Denmark; his bust of Professor Hansteen (purchased by the Art Union of Christiania), and his Shepherd Girl in terra-cotta is a most beautiful model. With her right hand she is shading her eyes, while in her left she holds the "luur," or horn of twisted birch rind, with which the Norwegian shepherds make the echoes of their native mountains ring.

The silver work here exhibited is also deserving of attention.

J. Tostrup contributes a silver vase, with some flowers and corn also in silver; the latter are made by peasants in his workshops.

L. Hammer shows some of the ornaments worn by the peasants.

Like the inhabitants of Holland, the Norwegians were in the habit of converting all their property into trinkets for the sake of having it in a more portable shape. This custom is, to a certain extent, still retained, although the original cause no longer exists. Two stuffed figures, representing a Norwegian bride and bridegroom, are decked out in the most approved style. The buttons, as with some of the Spanish peasantry, are mostly pieces of money, while the filigree ornaments are the traditional designs handed down from father to son: it may be remarked that the crown worn by the bride belongs to the parish, and is hired for the occasion.

A series of photographs of the costumes in different provinces of Norway, by M. Selmer, is a most interesting collection.

We may here notice also an upright and grand pianoforte, by Hals Brothers, as being of very good tone.

There also is a small model of a church, built by the peasantry, of wood, and said to be eight hundred years old. The frame of a looking-glass close by this model is carved with designs copied from the interior of this church, and is an interesting specimen of Scandinavian taste.

A feature of great importance for Norway is its vegetable produce, of which, notwithstanding its northerly situation, (between 58° and 71° N. lat.) this country makes a very good display. The superficial area of Norway may be estimated at about 121,800 square miles, half of which is situated at an altitude of more than 2,000 feet above the sea, while 3,200 square miles lie within the limits of perpetual snow.

It has been ascertained that corn will ripen in Norway under a much lower temperature than in more southern countries. Another curious fact is that plants whose roots, leaves, &c., contain some aromatic matter, develop this quality in a striking degree, the further they are found towards the north; even an interval of three degrees of latitude can produce a remarkable difference. The above facts, together with the phenomenon of oats ripening as far north as latitude 69° (the only instance in the world), rye as far as 69½°, and barley as far as 70°, are mainly attributable to the causes above detailed.

From observations made at Alten Copperworks, W. Finmasken, it has been ascertained that barley will grow 2½ inches, and peas 3 inches in twenty-four hours for several consecutive days. For a more detailed account of the vegetable produce and capabilities of Norway, we must refer the reader to Dr. F. C. Schubeler's book, "Die Culturpflanzen Norwegens" Christiania, 1862.

PERU.

SITUATION IN BUILDING.—*North Central Court.*

The Peruvian display is small; its chief feature being the silver filigree-work made by the Indians. Some trays and baskets, fabricated at Huamanga, are of good design and well finished. A piece of plata-pina, or crude porous silver moulded into the shape of a dog, is curious. A nun's rosary, made at Lima, and some relics from the ancient city of Grand Chimu, are highly interesting; as also a silver ornament, made by the nuns at Lima, and known as briscado work. Besides these there are collections of ponchos of various descriptions, and lace and embroidery done by the natives.

The straw hats and cigar cases of this country (especially a variety of the former called "Panama") are very fine and costly; but perhaps the finest specimen of straw-plaiting exhibited is a cigar-case, the property of Don Demetrio O'Higgins, made by the Indians of Chincha.

On the wall facing the passage is an oil-painting representing the kings, or Incas, from Manco Capao to Atahualpa.

PORTUGAL AND COLONIES.

Number of Exhibitors, 1363.

SITUATION IN BUILDING.—*At the corner of the Nave and the Central Avenue.*

Copper ores, iron pyrites, antimony, tin, lead ore, and some iron ores, are exhibited as representing the metalliferous minerals of the country.

Copper.—The exportation of copper from St. Domingo last year amounted to nearly 50,000 tons metrical. We believe much of this was coppery pyrites or sulphur ores, containing a very small percentage of copper.

The Palhal Mine produced, from 1854 to 1860, 5,065 tons metrical.

From Bracal they have extracted within the three last years 2,700 tons* of lead ore, which has produced 1,750 tons metrical.

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* The difference between the ton metrical and the English ton is, that the ton metrical is equal to 2,207 lbs., and the English ton to 2,240 lbs.

The lead from Moinho da Pena in general is very argentiferous; indeed, the sulphide of lead from most of the Portuguese mines is rich in silver.

There are some very excellent specimens of marbles, gypsum; lime, salt, coal, slate, flints, pumice-stone, are also exhibited.

From the colonies of Angola, Mossamedes, and Mozambique, there are several examples of interesting mineral productions.

Malachite, from the celebrated mines of Angola in Africa, is exhibited by Messrs. R. Taylor and Co. The deposits of malachite, in some of those districts, appear to be of an extraordinary character.

Chemical and pharmaceutical products are well represented; and the classes devoted to food, vegetable and animal products, have 729 exhibitors.

The Cape de Verde Islands furnish pharmaceutical products. Coffee, spices, tamarinds, tapioca, rice, &c., are sent down from Timor, the Isle of St. Thomas, Cape de Verde, and Angola. A good collection of woods is also exhibited from these colonial possessions, together with cotton, fabrics of cotton and silk, skins, tobacco, cigars, and numerous curious native manufactures.

We find maize, wheat, rice, and rye, as well as Indian corn of fine quality; also collections of seeds, such as grass, clover, wheat, barley, esparset, and others, generally of good appearance. Amongst the finest collections are those of the Agricultural Institute of Lisbon, of the Central Commission, of F. K. Soares de Moraes, and others. Almonds, walnuts, olives, and various species of peas and beans are shown in excellent quality, forming an important branch of Portuguese produce. There is no want of dried figs and other dried fruits; and olive oil of surpassing quality is shown by a vast number of contributors. We find preserved fruits of the most various kinds and of exquisite flavour, many sorts of preserved vegetable and preserved meats, and a variety of other articles, such as sugar, cheese, honey, chocolate, biscuits, and confectionery in general.

There is an extensive display of the celebrated Portuguese wines, amongst which is port of very best quality, and fine specimens of white wines. As an average, the prices may be called moderate, though some of the older sorts vary up to 6s. per bottle. Count d'Azambuja exhibits port of 1801, and of excellent quality. Bucellas of remarkably fine colour and quality is contributed by J. Ferrao Castello Branco. Malmsey, grown in 1842, is shown by Dabney. A. Bernardo Ferreira has a collection of wines of undoubted good quality, and of ancient growth, beginning as far back as 1756. Amongst the exhibitors of excellent red and white wines are also F. de Freitas Macedo, A. Ferrara Menezes, F. M. B. Pinto, the Royal Oporto Wine Company, and others.

Since the duty has been taken off soap, this has become an important branch of Portuguese manufacture; it is exhibited in samples of various quality, among which the marble olive-oil soap, shown by Castro Sibrat, Fillios, is deserving of attention, on account of its quality of preserving a soft skin.

The collection of tobacco contains, besides raw tobacco, an assortment of different kinds of snuff, and a fine assortment of cigars, varying in quality, some of which are of rich flavour and good manufacture.

A branch of industry affording employment to a great number of the poorer inhabitants, is the production of tooth-picks, manufactured from the wood of the willow, sold in commerce at incredibly low prices, and of which several kinds are exhibited.

Silkworm breeding is not as yet extensively exercised in Portugal, the climate of which is, however, peculiarly congenial to the silkworm. We observe some fine specimens of cocoons as well as of raw silk, both white and yellow.

Wool, both black and white, woollen fleeces, and flax, form a considerable part of the exhibition.

Cord-wood and manufactured corks are shown beside an interesting collection of specimens of timber and barks, amongst which are the woods of Angola, the bark of the cork-tree, sandal-wood, carvings, &c.

A selection of philosophical instruments, of good construction and workmanship, is exhibited by the Industrial Institute of Lisbon; and several sets of surgical instruments are shown by A. Polykarpo Baptista, amongst which is a large case of instruments of remarkably good workmanship.

We find crochet work, cotton quilt, cotton drills, and all kinds of cotton fabrics, as well as linen fabrics and thread, cords manufactured from New Zealand flax, and fabrics.

Manufactured silks and silk fabrics are exhibited, though not to any great extent. The silks and shaded satins shown by E. M. Ramires, and A. I. Barbosa Araujo, are worthy of attention.

There is a creditable display of woollen and worsted fabrics, such as kerseymere, blankets, quilt and cloth, Bilboa shawls, &c., as well as of embroidery, the most attractive piece of which is a representation of the statue of Joseph I., so exquisitely finished as to be easily mistaken for a drawing. It was executed by a lady (M. L. Do Amaral) of Lisbon, who employed three years in finishing this masterpiece of embroidery.

Amongst the specimens of tanned skins and hides, the most remarkable are the finished morocco skins, exhibited by J. G. Pereira Callado, which are the more deserving of attention, as, until very lately, this manufacture was at a very low point.

A good display is made in articles of clothing, comprising hats, boots and shoes, and an interesting specimen of lace manufactured from the fibres of the aloe.

We observe some good specimens of printing and lithography, comprising a collection of maps and charts, and a creditable show in bookbinding, amongst which are albums handsomely bound in morocco leather.

An attractive part of the show is formed by some easy seats, a sofa and mattresses, such as are used in the hot climates, manufactured from reeds. Though rather clumsy in appearance, they are light, elastic, and extremely cool, and thus well adapted for use in hot weather.

Some display is made in pottery, amongst which is a stone-china service of good appearance, and various kinds of earthenware and drainage tubes.

ROME.

Number of Exhibitors, 53.

SITUATION IN BUILDING.—*Near the Cromwell Road Entrance, South Central Court, on the Central Avenue.*

The Roman Court is distinguished by its sculpture. The delight experienced in looking on the Beautiful prevents the visitor from noticing the poverty existing in the works of industry.

A breviary presented to Cardinal Wiseman by the Pope, and a case of ebony for it, begins the catalogue enumeration: and a reliquary and two statuettes, copies of statues in front of St. Peter's, conclude it.

A few earthy minerals and some iron ore show the products of the soil. Potash, alum, salt and smalts, its chemical works. There are six exhibitors of corn and candles: some crucibles, a few tools, an ingenious machine, and several photographs of a superior character.

Silk fabrics embroidered, and some lace and tapestry, are fine examples of this class of work.

L. M. Manzi exhibits some beautiful tables of breccia, and the Marquis S. Papazzurri Muti has an inlaid table of fine character, and one of the Lunnachello marble, the internal reflections of which are fine. There is a good collection of Roman pearls and some metal work—chiefly in the Pompeian style—of a very creditable character.

RUSSIA.

Number of Exhibitors, 729.

SITUATION IN BUILDING.—*North-West Court and North-West Gallery.*

The most attractive feature of the Russian trophy is the Siberian products shown by Mr. Alibert. Mr. Alibert some years since visited the mountains N.E. of Lake Baikal, between the rivers Oka and Irkoutsk, where, while in search of auriferous sands, he found traces of pure graphite. Knowing the value of this mineral, which had hitherto only been found in the celebrated Borrowdale Mine in any quantities, he continued his researches, and in 1847 succeeded in discovering large quantities scattered over the surface of one of the spurs of Mount Saïan. He immediately commenced a series of operations, and after eight years of incessant labour, at length succeeded in finding a considerable lode of this valuable mineral.

Mr. Alibert has several cases with specimens of this mineral, showing not only its quality in the rough state, but also that it will take a high polish, and can be carved for ornamental purposes. The largest of these cases, valued at 4000*l.*, has been presented by Mr. Alibert to the "Conservatoire" of the "Arts and Metiers," at Paris. It is composed of a polished block of graphite, around which are grouped artificial crystals and gigantic pencils, some of which are held by hands of graphite, finely carved. The whole is surmounted by a bust of the Emperor Alexander II. On the reverse is a bust of Yermack, the conqueror of Siberia.

In another case is a lump of nephrite, discovered in the graphite mine. This stone, which is of great value, has hitherto only been found in China, and to Mr. Alibert is due the merit of having discovered the largest block ever found; it weighs 1624 lbs. and was valued at 2000*l.* After its discovery it took one year to convey it to the mine. The beauty of this stone for ornamental purposes is shown by a vase exhibited opposite this case.

In the same case with the nephrite is a collection of eight Siberian sables of different species. Here is also an album containing 150 water-colour sketches of the most interesting views in Siberia. Some of these are shown on the pedestals of the cases containing the graphite. Another album collected by Mr. Alibert during twenty years' travels in China and Siberia, he has presented to the Empress of Russia; on the outside it bears the Imperial arms, and it contains four hundred paintings on rice-paper, silk, &c., by Chinese artists.

The central portion of the trophy contains a number of imitations of flowers and fruits in precious stones that deserve particular attention.

They are exhibited by the Peterhof Stone-polishing Factory. The first of these is a black marble table inlaid with a wreath of vine leaves in nephrite. The centre is formed by a bunch of grapes in amethyst, surrounded by red, white, and black currants in cornelian and garnates. After this is a casket, the cover and panels of which are decorated by bunches of fruit in relief. The raspberries are rubies and coral, the gooseberries quartz. The same fruits and stones occur, and a number of paper-weights, on one of which is a lizard in nephrite. It may be fairly said that fruits have never been more beautifully imitated.

Two china vases, with the portraits of Inigo Jones and Locke, have been presented by the Emperor to the Royal Society. Near these is a fine candelabra in jasper, which it took ten years to complete. An ebony cabinet, sent by the Empress of Russia, is a beautiful specimen of mosaic. The ground of black marble is inlaid with bunches of convolvulus in lapis lazuli, verbena in opal, myosotis in turquoise and lapis lazuli, bellflower in chalcedony &c., &c. A table of lapis lazuli, handsomely inlaid, is also noteworthy. Besides these, there is a large and handsome flower-vase in porphyry. Some vases of lapis lazuli, and inkstands and ornaments are also very fine, as also a vase of nephrite, and a bronze model of a gigantic statue, proposed to be erected to the Empress Catherine II. in the Summer Palace.

Two fine columns in jasper and porphyry complete this part of the Russian exhibition. In front of the latter is a fine representation of sledgeing in silver.

Another display of great interest is that made by the Imperial Glass Works. These works manufacture chiefly for the royal family of Russia, and none of their works are therefore for sale. The chief feature in this display appears to be the "jewelled" glass which they produce in great perfection. Some china tea-services here shown are very handsome, and merit inspection. We may notice one with ancient cameos imitated on a ground of cobalt blue.

In immediate connexion with the Imperial Glass Works are the Mosaic Works (646). These chiefly manufacture for the decoration of churches and cathedrals, wherefore the subjects produced by them are all of a religious character. The artists employed in designing and executing the mosaics are all pupils of the Academy of Fine Arts at St. Petersburg. The objects here exhibited are a gigantic picture of St. Nicholas, and two angels after Raphael. These mosaics most successfully rival those of the best Roman masters. They are composed of pieces of glass, a case of which is exhibited in this Court. It will be understood that the glass is dyed while in a liquid state, by which means it may be cut to any depth without changing its colour, as is the case with stained glass.

The same case contains a collection of amber from the Baltic provinces (the chief curiosity of which is that each contains an insect perfectly preserved), and a collection of forty-seven Russian medals.

Colonel Likhatcheff exhibits two machines for making barrel staves. One is intended for bending the staves by pressure between moulds, and cutting the edges, by means of a horizontal saw. The other machine is used in cutting out the interior curve of the staves, by means of a peculiarly-arranged semi-annular saw.

The display of precious metals is one of the most prominent features of the Russian exhibition. Like most of the objects from this country, it bears a distinctive feature. A great proportion of the objects here displayed bear a religious character.

V. Sazïkof displays a number of articles in silver and silver-gilt. The most prominent of these is a New Testament, the cover of which is set with turquoises and pearls on a ground of very fine filigree-work, around which are representations of the Apostles, on china. A tankard, in imitation of the trunk of a tree with ivy clinging to its sides, and the handle formed by a broken branch, is of great beauty. A drinking-cup with repoussé figures is also very handsome. A number of seals and tobacco-stoppers of silver-gilt are remarkable; they are all representations of Russian peasantry, and are interesting on account of the costumes.

A silver representation of a race in a sledge has great life and animation.

Besides these, this case contains a number of trinkets and ornaments too long to be enumerated. A silver representation of a ladies' white satin shoe is a faithful copy. There is also a looking-glass with solid silver frame of great beauty. Another case contains a Greek missile and some other objects equally handsome.

Gold and silver stuffs for the use of the clergy are exhibited, of very rich design.

Some good specimens of raw silks are shown by the Commercial School of Moscow. A. Nissen sends silks, spun from cocoons produced in the south of Russia. Wool is also exhibited in large quantities, the best being that sent by the Agricultural Department, St. Petersburg, and the Grand Duchess Helen Pavlovna.

The collection of skins and furs is also of great beauty; some of the best are sent by the Russian American Company, among which some sea-otter skins are prominent. The blue and silver fox skins are also worthy of notice. H. Shraplan has sent a carpet and morning-gown of fur, and the Archangelsk Chamber of Crown Domains, a prepared swan-skin.

Here may also be mentioned a number of bronze and iron castings of great merit. Three small hunting scenes, cast in iron, are perhaps among the most graceful objects of this kind exhibited.

They represent a hare, a wolf, and a fox-hunt; and the finish of all the details is a marvel of workmanship. Nothing could be more natural than the hound watching over his master's shoulder the captured wolf; while another requires a touch of the long and heavy whip to induce him to loose his hold of the dead fox. Russia has contributed but one clock, which is, however, made with much taste.

The immense grain trade of Russia is well represented, and includes every variety of seed grown over that vast empire. There are oats and maize from Bessarabia, barley from Archangel, wheat from Pultowa and Tshernigof, madder-root from Astrachan, and nuts of all kinds from Trapezund, besides many more. Tallow is also well represented. Bristles, which are an important feature in Russian commerce, are shown in some quantities; the best exhibitor of these is A. Mamontof.

The collection of leathers and textile fabrics is large and of some importance; but it would lead too far to give a detailed description of these objects.

Among some educational works is an interesting series of models showing the difference of the features in the various human races. Among a display of hats and caps is a Siberian woman's head-dress, (or kokoshnik) made of birch-rind, and most elaborately carved.

A fine display of cigars and tobacco is also made: as the best exhibitors of which we may mention Bostanjoglio and Sons, F. Heinrichs and A Töpfer.

The wines from the Crimea are well represented, but their quality is a matter of taste.

Carriages and sledges are also exhibited, but they are not of very great importance.

Not so the photographs, which are of superior quality. The best of these are contributed by Denier, and include a portrait of the Grand Duke Constantine.

The cutlery and arms displayed in this Gallery are of good quality, particularly the latter, among which a collection of sword-blades and a cast-steel cuirasse, and some Caucasian fire-arms and swords, all richly inlaid, are noticeable.

A collection of dressed skins, and some Caucasian costumes, complete this Gallery.

SANDWICH ISLANDS.

SITUATION IN BUILDING.—*North Court, by Ionian Islands.*

This collection having arrived very late, does not appear in the catalogue.

A lithographic portrait of King Kamehameha IV., proves that European dress has been adopted by the court.

The art of printing seems to have made considerable progress.

Two boxes in "koa" wood, presented by the King to Lady Franklin, are made with great neatness. Two photographic likenesses of a half-caste child and a native woman show that the inhabitants of these islands are considerably better looking than their brethren of other parts. There are some feather ornaments shown, the most curious of which is a bright yellow tippet, formerly worn by high chiefs.

The bird from which this tippet is made, is quite black, with only one yellow feather under each wing, which is plucked out year by year. A collar of human hair, having a whale's tooth in the centre, also belongs to the ornaments of the past.

There are also some straw mats, and the root from which an intoxicating drink called "awa" is made.

Sugar, molasses, coffee, lime, &c., are exported, but in small quantities, while the imports consist chiefly of articles of British and American manufacture.

SARAWAK.

SITUATION IN BUILDING.—*North-west Court, British side, near Music.*

The display made by this country, and which has been but lately admitted into the Exhibition, is of little importance. Its mineral wealth is represented by two fine blocks of antimony, and some gold dust; while its vegetable produce shows sago, flour, and pearl sago, vegetable tallow, and cotton. Some woods are good, especially the "Red Siraugi," which, on account of its hardness and durability, is well adapted for ship-building purposes. Native weapons are largely shown, some being of excellent quality.

Some straw and reed mats will prove interesting, on account of their peculiar pattern.

A bead girdle of a Malo Dyak woman, is curious; as also a number of rings, and some ear-drops from Sarawak.

SIAM.

SITUATION IN BUILDING.—*North Court, British Side.*

Sir R. H. Schomburgk, H.M. Consul at Bangkok, has sent to the Exhibition silk petticoats, worn by the Lao and Burmese females; ditto of a Karen, ornamented with Job's tears (seeds of Coix); cotton coverlets of Lao and Karens, travelling bags, cotton thread and spindle, fauteuils of carved teak wood, collection of walking-sticks, samples of paper, native-made Lao cutlasses, and a collection of trade products and medicines.

A. Markwald and Co., of Bangkok, contribute a collection of Siam products, consisting of silk, cotton, and other fibres, rice and pulse, resins, dye-stuffs, and tanning substances, sugars, coffee, woods, and animal products.

Mr. P. L. Simmonds, specimens of horns, feathers, edible birds' nests, shark-fins, beche-de-mer, stick-lac.

Mr. W. P. Hammond, a collection of ornamental articles; and Sir J. Bowring, various articles illustrating Siamese art.

SPAIN.

Number of Exhibitors, 1133.

SITUATION IN BUILDING.—*The South-West Court and South-West Gallery adjoining France and Italy.*

The country producing as great a variety of mineral treasures as any in Europe—and one which certainly appears to promise a higher reward to well-directed mining enterprise than any other—is the most imperfectly represented in the Exhibition. Owing to some neglect—to whom it is to be referred we know not—by far the best part of the mineral collection sent to this country remains unpacked, and thus no opportunity is really given to the inquirer of examining specimens which, we are told, were collected at great cost and with much judgment.

Coals are exhibited from the Asturias and some other districts. The Asturian coal-field promises, when fully developed to become a very important one.

Iron ores of varied character are exhibited from several districts.

Copper, tin, lead, blende, cinnabar, antimony, silver, and other minerals are sent from Burgos, Galicia, Granada, Guadalajara, Rio Tinto, Asturia, and several other districts. Kaolin, rock salt, gypsum, sulphur, phosphates of lime, and many other valuable earthy minerals will also be found in the collection. A small bay in the gallery contains all the minerals exhibited, and these are imperfectly arranged and named.

The chemical substances are few; there is nothing remarkable amongst them.

The agricultural products are large; cereals, oils, fruits, and wines have no fewer than 594 exhibitors. These are things which do not admit of description, unless the whole question of production and preparation is fully entered into, which is not possible in the present volume.

Cork, hemp, dye drugs, oils, wax, gums, and various productions, animal and vegetable, are exhibited.

A waggon wheel constructed to move without friction on the axle, and a model of a locomotive to be moved by hydrogen gas, and a model of rails, is all that has been sent from Spain connected with machinery, excepting one or two presses, a few agricultural implements, and the "hiponcetro" for measuring horses.

Military uniforms, a few rifles and a piece of ordnance, and a diving apparatus, represent Classes XI. and XII. One chronometer, a piano and piccolo, a few strings for musical instruments, and some half-dozen articles connected with surgery, are found in the class following.

Cotton and its manufacture, flax in all its various states, silks in considerable variety, wool and worsted in every stage of manufacture, laces of very fine character, a few furs, hides, Andalusian harness, gloves, and hats, well represent the classes devoted to textile fabrics, clothing, &c.

Paper and stationery have but a small display.

The furniture class contains a few objects of interest. There are a few mosaics in wood, a group in marble, Venus and Adonis, some work in mother-of-pearl, and some good examples of damascening.

In Class XXXI., Spain exhibits *unoxidizable* iron, and "iron decomposed without losing its elasticity,"—we must confess to a very imperfect understanding of either one or the other.

There is a little jewellery and filigree work.

There are two exhibitors of glass and thirteen exhibiting porcelain and clay.

In the latter class there are some very delicately modelled Malaga figures.

The miscellaneous class has nothing of a special character.

SWEDEN.

Number of Exhibitors, 570.

SITUATION IN BUILDING.—*North-West Court and North-West Gallery.*

The display made by Sweden is much more important than that of many other countries, when compared to its population. The chief wealth of Sweden lies in her mines, although her forests and agricultural produce contribute materially towards it.

In Class I. there are many important collections.

Baron Adelswärd exhibits specimens illustrating processes used at Avidaberg Copper Works.

From the Baldersnäs Iron Works we have steel-iron, produced from best Persberg ores, by a method introduced in 1829, the owner taking over seventeen English workmen.

The Bispberg Mining Company sends a large specimen of iron ore: this sample weighs 16 cwt., and contains ·01 per cent. phosphorus.

The Dannemora Mining Company have numerous specimens of their iron ores, and rocks in which they occur. These ores are considered the most valuable in Sweden, and the iron made from them is sent to this country for the manufacture of steel.

Suber and Co. exhibit bog and lake iron ores, called in the country pearl, bar, money, cake gunpowder, and bog-ore. These ores are considered in the country to be produced by animalculæ forming their shells round them. They are collected in winter when the lakes are frozen, through holes made in the ice.

F. Killander exhibits iron ores from Taberg Mines, and bar-iron twisted cold, considered the softest iron in Sweden; it is much used for wire.

The Kloster Iron Works, Siljansforss Iron Works, Carlsdahl Iron Works, and F. Göransson exhibit "Bessemer" steel, introduced after great expense and labour.

The Stora Kapparberg Mining Company exhibit iron pyrites containing 44 per cent. of sulphur; price per ton at Gefle 6*d.* for every per cent. of sulphur.

The Sala Silver Works exhibit silver ores. Pure galena contains 0·5—0·75 per cent. silver. Produce in 1860 was 47 tons lead, 2160 lbs. troy, silver.

A branch of the Vieille Montagne Company exhibit zinc.

J. Sederholm exhibits cobalt from Tunaberg, of three kinds.

The Motala Iron Works send the bow of an iron steamer which struck a rock, going nine miles an hour. She was, however, got off, and proceeded on her journey. Though the bow was completely doubled up, no water was admitted.

Erdmann, placed in Class XXIX. in error, exhibits some beautiful geological maps of Sweden, and a collection of forty-six cubes of Swedish rocks; giving specific gravity and amount of water absorbed after 100 hours' immersion in water.

Some good specimens of porphyry are shown, and the vases made of these stones are very handsome.

There are also cooking utensils of talcstone, used for preserves as it is not affected by acids.

Excellent samples of wheat, barley, peas, rye, and vetches are exhibited by the Agricultural Society of East Gothland.

Y. Gyllencreuz has sent some wheat grown within ten miles of the Arctic circle. The clover seed exhibited by Baron Sprengtporten is of excellent quality.

Beet-root sugar is chiefly used in Sweden, and in 1860 twelve factories, employing 1219 persons, produced a value of 662,482*l.*

The culture of the tobacco plant was introduced into Sweden about four years ago, since which time it has been on the increase. In 1860 it occupied 2½ acres of ground, chiefly in the vicinity of Stockholm. The rest of the tobacco manufactured in Sweden is imported partly from Bremen, partly from Hamburg. In 1860, 103 factories, employing 1883 persons, produced tobacco to the amount of 253,897*l.*

H. Kylberg exhibits some tobacco grown near Stockholm.

Cederlund and Son exhibit some arrack punch and brandy, for which Sweden has long been famous. In 1853 it is estimated that the production of brandy reached the enormous amount of 14,400,000 gallons. This is, however, considerably decreasing.

The culture of the silkworm, introduced into Sweden in 1737, has since then been steadily increasing. Under the auspices of a Society formed in 1830, 160,000 mulberry trees have been planted over different parts of the country. J. Rossing some years ago adopted the plan of feeding his silkworms entirely on the *Scorzonera humilis* and *hispania*, and it has been found that none of the worms produced from eggs sent by this exhibitor to Switzerland have suffered from the disease to which all silkworms are liable.

Wool is exhibited in good quality, but not in large quantities.

The collection of woods sent is very good and of importance, particularly when their commercial value is considered.

To this class also belongs a quantity of wood-carving which, like that of Norway, is executed chiefly by the peasantry. A tankard, by a peasant woman of East Gothland, shows great talent, also a frame carved in oak by P. Dalin.

There is but one exhibitor of sword-blades, J. Svengren. These are made of different qualities of steel to show their respective merits.

The display of textile fabrics, though not very large, is important on account of the quality of the articles shown.

In 1860 there were in Sweden twenty cotton mills, with 166,966 spindles, employing 4,021 persons; the produce from these mills was 13,730,589 lbs., which in 1861 rose to 13,894,665 lbs., valued at 738,911*l*. In 1860 twenty-seven linen manufactories of cotton and linen goods, with 2,438 looms, employing 1,677 persons, produced 253,380*l*. value.

Besides the manufactories, large quantities of cotton goods are annually produced by what is called the "home-industry," or peasants weaving at hand-looms in their own houses. In 1860, the province of Westgothland thus produced 21,573,675 feet. S. Anderson exhibits some excellent qualities of the latter; also S. Larsson.

Damasks and silks are of excellent quality; of the latter there are four exhibitors.

The skins and furs are good, particularly those sent by Forssell and Co., which include the beaver, marten, squirrel, and otter.

Sweden has long been celebrated for gloves, and the display made, though not very large, contains some excellent specimens. The best goat skins used in the manufacture of gloves are imported from Switzerland, Saxony, and Italy; the lamb skins from Hungary, Illyria, and Serbia. The latter are not so good as the former. Sheep skins are obtained in Sweden and Jutland.

Paper is exhibited in some quantities and excellent quality. The oldest paper-mill in northern Europe is said to have been founded by the celebrated Tycho Brahe, between 1570 and 1580. This is the Klippau mill in Scania, which has continued in constant work ever since.

The Rosendahl Company exhibit some paper made of pinewood. The wood is ground to a fine pulp (some of which is shown), and then treated like the pulp made from rags.

A collection of drawings from Scandinavian churches and monuments, by W. Mandelgren, is highly interesting.

G. Ljunggren shows some maps of the divisions of parishes. Formerly the land belonging to parishes was much divided and subdivided, one man perhaps owning small plots of ground at many different places. This was obviously an impediment to the progress of agriculture, and a law was therefore made that, upon the demand of any landed proprietor, the entire possessions of the parish should be redivided, each man having all his ground allotted to him in one place. This has been done frequently with very good results. A plan of several parishes, before and after the redivision, is shown. Besides these there are many maps and charts exhibited by the Swedish government, of excellent quality.

G. Linderoth deserves notice for two chronometers with new escapement, in connection with which are shown L. Mollberg's compensation balances and spiral springs for chronometers, of such excellent quality that they may be drawn out quite straight without becoming damaged.

The Swedish trophy contains one of the finest pieces of casting exhibited. The subject (taken from an ancient Runic tomb) is, the origin and consequences of a quarrel between two Swedish peasants. The story is admirably told by four "relievos" round the base, while the duel forms the principal subject. The two men appear strapped together round the waist, armed with knives, and struggling violently. The fight has ended fatally for the younger, for his bride is represented praying at his tomb. On the tomb is the scroll (generally a serpent), in which all Runic inscriptions are made.

Here are also some good ordnance. The peculiarity of all Swedish guns is, that they are cast from the High Furnace, instead of the metal being previously refined. The larger of the guns here shown is on the construction invented by Captain Engström, and has been adopted in the Swedish service. The breech-loading construction is very simple. The breech opens like that of the Whitworth guns, but instead of a screw it has a wedge, which by receiving a half turn closes and retains the breech. The smaller, by A. Stockenström, has an oval bolt which passes through a slide in the breech cutting the bore at right angles. This gun is one of three tested to bursting, when it was found that they were all three of precisely the same strength.

There is also some good china exhibited by Sweden; foremost amongst which are three small tables of very good design, by the Gustafsberg Porcelain Company, and B. R. Geijer.

There is not much plate, but it is of good quality. The most prominent object is a punch-bowl in silver-gilt, the property of the Par Bricol Society, founded by Gustavus III.

SWITZERLAND.

Number of Exhibitors,

Situation in Building.—*North-West Court and North-West Gallery.*

By far the most interesting portion of the Swiss display consists of watches and their parts, of which about a dozen of the best makers have contributed every variety. The secret of the excellence of Swiss watches lies in the fact that each workman confines himself to one particular branch; thus U. Lecoultre makes only "pinions" or wheels, for which he has acquired great celebrity; Cornioley and Son produce only the finer description of tools; others only hands, faces, screws, &c.

A. Dubois and F. Kundert, both from Chaux de fonds, have sent specimens of engravings on gold for watch-cases, that may defy competition by the best makers of any other country.

Chronometers were until lately but little made in Switzerland, but their manufacture is now becoming more general. H. Grandjean sends some specimens said to rival our own in accuracy.

There is a great display of fancy watches from Geneva; the more solid articles are made at Neufchatel.

The machinery from Switzerland is placed between the Austrian and Belgian departments. The objects exhibited belong entirely to Classes VII. and VIII.; Class V. is unrepresented.

Messrs. Escher, Wyss, and Co. exhibit a pair of compound cylinder (Woolf's) engines, arranged for a shallow draft river-steamer: the cylinders are fixed in an inclined position, and an independent engine is employed for working the air and feed pumps. This auxiliary engine is worked with high-pressure steam, and the exhaust steam blast is carried into the funnel, for the purpose of increasing the combustion of the coal, so that a boiler with a given amount of heating surface can by this means be made to produce more steam than it would do, under the ordinary conditions, with an unaided draft.

These engines are nominally of 30 horse-power, but they are intended to develop an effect of 180 horse-power, in which case the consumption of coal does not exceed 2¼ lbs. per actual horse-power per hour, as determined by the indicator.

Mr. J. Beugger of Winterthur, sends a roving frame for cotton-spinning, in which cans are used instead of spindles and fliers. Several advantages are claimed for this principle; it is said to work with less noise than the ordinary roving-frame, and with only one half the number of attendants, while the quality of the rovings produced is said to be improved, owing to the avoiding of all injurious strains on the fibre.

Messrs. Wahl and Sogin's ribbon looms are beautiful examples of the application of machinery to the finer class of silk weaving. The larger one is a combination of eight ordinary Jacquard looms, all of which are working with one set of cards. The shuttles are arranged in a sliding box carrying six different coloured wefts one above another. The ribbon produced bears a representation of the Royal Arms of England, with a wreath of flowers, and an inscription. There are 1,500 threads in the warp, and the pattern requires 2,000 cards. It will be evident, on a slight inspection of this loom when at work, that a combination of several looms into one frame is advantageous, as the delicate nature of the fabric requires a slow motion of the shuttle, and therefore a considerable production can only be obtained by weaving several pieces simultaneously.

The smaller loom, which is weaving a portrait of the Queen in three colours, is working with a pattern containing 700 cards.

Messrs. Sulzer Brothers exhibit a machine for washing and squeezing woven fabrics, which is driven by a small direct-acting steam-engine attached to it.

The Haag type-foundry exhibits a machine for casting printing types which resembles, in principle, that exhibited by Besley and Co. in the English division.

Messrs. Landolt and Milster send an apparatus for making maccaroni, vermicelli, and similar preparations. It consists essentially, of a large hydraulic press, which is furnished with brass moulds, resembling those of a drain-pipe machine.

Mr. B. Gruner exhibits a folding, stitching, and glazing machine for bookbinders, by which from 10,000 to 12,000 sheets can be folded and prepared for binding per day.

As a specimen of minute workmanship, a Lilliputian pistol, sent by L. Audenay, is perhaps unique: it is said to consist of as many parts as a real pistol, and might be used as such could powder and ball be made small enough. This formidable weapon can, however, only be properly examined by the use of a magnifying glass.

The most remarkable piece of mechanism in this Court is H. L. Cretillat's astronomical and geographical clock. It would lead too far to enter into a detailed account of the construction of this masterpiece of mechanical skill, which shows the exact time at twenty-two different parts of the globe, the days of the week and month, and the exact time of the rising and setting of the sun, with its exact position, besides having a barometer and thermometer. It is valued at 2000*l.*, and the models from which it is made have been destroyed, so that the purchaser may be sure of possessing the only one of the kind.

Though not so celebrated as their Vienna competitors, the Swiss musical-box makers have contributed some very fine specimens, and appear to have excelled in singing birds more particularly.

But little wood carving has been sent, but it is all of excellent quality and design.

A branch of great importance to Switzerland are her textile manufactures, which are mostly for export to eastern markets, and have the important quality of being according to the taste of intending purchasers. Of these Müller and Co., and

A. F. Rikli have sent some good specimens, while Hübler and Co. exhibit artificial woollen goods made from old rags, &c.

Basle and Zurich have long been celebrated for their silk manufactures, the former chiefly for ribbons. Bischoff and Son are the chief manufacturers of the heavier kinds of silk, while other firms produce cheaper and lighter stuffs, the patterns on which are, in many cases, copies of those from Lyons.

The lace and embroidery, both by hand and machinery, is also of importance. B. Rittmeyer and Co. exhibit a curtain, the largest piece of work ever embroidered by machinery; in this quality it deserves notice, but the very high price (120*l.*) renders it of comparatively little commercial importance.

The Swiss point exhibited by J. Braenzinger is of most beautiful design and neat workmanship.

The Cantons of Aargau and Freiburg carry on an extensive commerce in plaited straws, of which Saler and Co. exhibit the best qualities.

The furniture from this country is good, though it does not equal that of France and Italy. There is a writing table that may be converted into a standing desk, and a sideboard shown is also deserving of notice; it is ornamented with pieces of oak soaked in water, containing particles of iron.

Regulation military and sporting rifles are also exhibited; little exterior ornament is applied, and they differ uniformly in the size of the bore from the rifles used in other countries.

Chocolates and cigars are shown in good quality; of the latter we may draw especial attention to the "Veveysans," which are only made in Switzerland, and have a most agreeable flavour. Bertholet and Co. are the chief exhibitors of these.

Among the wines and liqueurs are some artificial champagnes made from Neufchatel wines by Bouvier Brothers.

Kirschwasser, or cherry water, for which the cantons Schwyz and Zug are celebrated, is well represented. This liqueur is distilled from the wild cherries after they have been separated from the stones, and when quite pure it is free from all hurtful substances. A stronger quality is produced by distilling the stones, but this may be easily detected by the flavour of the essence of bitter almonds, although not in sufficient quantity to produce any injurious effect.

Aarau has long been celebrated for its manufacture of philosophical instruments. The display of these, though not very large, contains articles of excellent quality.

M. Hipp has sent some telegraphic apparatus, and Amsler-Laffon contributes an ingenious invention called by him a planimètre, designed for calculating space on topographical maps.

T. Daguet exhibits two large discs of crown and flint glass of remarkable purity.

Iron and copper wires are also shown: the former are made of Swedish iron, which alone is adapted to this description of work. One piece by Nenhaus, though 60,000 feet long, weighs only 2 lbs. The iron ores found in the Jura Mountains are of excellent quality, but too difficult of access to prove of much commercial importance.

Some specimens of inlaid floors also deserve attention, though not so good as those shown by Belgium.

TURKEY.

Number of Exhibitors, 787.

SITUATION IN BUILDING.—*North-West Court and North-West Gallery, near the Horticultural Entrance.*

The objects of most attraction in this Court, are the silk and velvet embroidered stuffs, the best of which are exhibited in the form of a trophy, in the Nave.

The Governor of Albania has sent some very handsome specimens of Albanian costumes, of velvet richly embroidered with silver-gilt. When no longer fit for use, they are burnt, and the silver collected.

The Governor of Scutari exhibits a cloak of red cloth, also richly embroidered. These are made in Albania, but are worn by the Kurd ladies.

In this case are also two "mashlas," or cloaks of green silk worn by the Arab chieftains; they are valued at 20*l*.

A coffee service in filigree silver is of excellent workmanship.

A rotatory steam-engine, by Mr. Serkis Ballian, of Constantinople, is remarkable for its novelty and simplicity. It consists of an oval cylinder, traversed by a rotating shaft, placed eccentrically. A rectangular slot is cut through the middle of the shaft, in which a square plate moves freely through a packed joint. The sides of the plates are furnished with spring packings, keeping it in contact with the inside and ends of the cylinder, so that, on steam being admitted on one face of the plate, it is forced round, and communicates a rotatory motion to the main shaft. No slide-valves or other machinery for the distribution of the steam, is employed beyond a simple admission valve.

K. Zumberekdji exhibits a string of amber beads of great value. They are made of the much prized lemon-coloured amber. Some mouth-pieces of the same material are of great size and purity.

The Constantinople amber manufacturers import their amber chiefly from the Baltic provinces.

In the trophy, there are also some handsome gauze veils, such as are worn by the Greek and Turkish women.

Until lately, Turkey was comparatively backward in manufactures. To remedy this, the government has established and encourages silk manufactures in many parts of the country, the chief of which are at Broussa. These have sent a collection of raw silk, to which private firms have added considerably.

B. Torrosoglon competes successfully with Italy, and Fathalla Kolzi has acquired the art of producing silk of greater strength than his brother manufacturers.

The brocaded silks, some of which are made by the Nomad tribes, are remarkable on account of the complete novelty of their designs. 323 come from Aleppo, and are worked by hand. Silk rowing shirts and towels embroidered by hand are curious.

Some full relief coloured lace flowers are of the style formerly used for head-dresses, but are now out of fashion. The wool fabrics of Angora are also well represented. It is said that the women attach much importance to wetting the thread with their saliva before drawing it on the distaff, and it is asserted that the thread spun during the time their principal food consists of melons, is far superior to that of any other time.

Some stuffs used for ottomans, &c., are also shown, and a military shabracque richly embroidered.

Of carpets there is a large display: the greatest number come from Ushak, Sarookan, Phillipapoli, and Salonica; the two latter produce only the "Kilim."

The cereal produce of Turkey is of great importance: and is well represented in the present Exhibition.

Pipes are exhibited in some quantities: the stems are mostly of jasmin, covered with straw or gold embroidery. The jasmin from the neighbourhood of Constantinople is preferred to any other wood. A "Nargila," or "Hookah," of steel, inlaid with gold, is of great value and much admired.

THE UNITED STATES.

Number of Exhibitors, 113.

SITUATION IN BUILDING.—*At the South-east corner of the Building, the British Exhibitors' Entrance.*

The unfortunate condition of this fine country has prevented our having the satisfaction of recording a large gathering of the examples [of its native productions—and its industries. Let us hope that the evils of war will shortly give place to the works of peace, and that the progress of industry may not be again impeded.

Feuchtwanger exhibits 1000 specimens of American minerals —Mr. Meads has a small collection of Lake Superior minerals, and the New Jersey Line Company exhibits some of their products.

Mr. Mosheimer is named as the exhibitor of a collection of Californian minerals—but these were, it appears, collected by Mr. Claudet, who, some little time since, visited the Nevada Territory: Dr. Precht exhibits some specimens of crystallized gold. At the entrance to the Eastern Annex are some remarkably fine specimens of American cinnabar from the Californian quicksilver mines. The crystal carbon oils exhibited are very fine examples of this product. Of the cereals, &c., little may be said.

The American machinery is placed partly in the Western Annex, and partly in the Court under the South-east Tower of the main building.

The most important article exhibited is a loom for weaving tufted pile carpets, which is placed among the English looms in the Western Annex. The arrangement of this machine is very peculiar; no Jacquard pattern is used. The yarns for forming the pile warp are wound on to horizontal reels, which are mounted into an endless chain. At every stroke of the loom one of these reels is removed from the chain; the necessary length of yarn to form the pile is reeled off by a series of hooked wires, and cut off by a vibrating knife-blade. The tufts are secured in their places at the next shoot of the shuttle, and the reel is returned to its place in the pattern chain, to be replaced by the following one, and so on. This loom is capable of producing twenty-five yards of Axminster carpet daily.

A scutching machine, for aloe or flax fibres, and a machine for spinning rope from Manilla hemp are placed in the Western Annex, among the Belgian machinery.

Sewing-machines, and a machine for fixing the soles on to boots, together with numerous other small machines, are placed under the South-east Tower.

A steam fire-engine, with vertical boiler and a rotatory pump, is now placed in the centre of the Nave, near the Italian department.

Eckel's press is certainly well constructed, and will, no doubt, fulfil all that it professes to do. The press can be run up or down in half a minute. The labour of pressing a bale by hand is accomplished in four minutes. The bale can be made, pressed, and compressed, in one operation. It occupies a small space, say six by eight feet. It entirely obviates the trouble of tramping. The whole amount of cotton or other substance for each bale is put in the press box at once. The doors around the bale fall, so as to allow free access for ropeing and sewing the bale after it is pressed.

For oils or other liquids it is recommended, as not liable to get out of order. It does more work, yields more oil, saves more labour than any other press. The oil or liquid is allowed to escape with the utmost freedom, both from the curb and the substance under compression, and only has to pass one-half the usual distance in making its escape. The curb can be stripped in three minutes. The cheese can be taken out, the press cleaned, curb set ready for refilling, in less than ten minutes. It yields more oil from the same amount of scrap than any other press.

The agricultural machinery is very good, and the reaping machines appear still to maintain the foremost rank.

There are three or four excellent pianos and some violins of new construction.

There will be found a miscellaneous group containing many articles of interest, such as washing-machines, rifles—Colt is an exhibitor—some good maps and books, a little furniture, and specimens of bank-note engraving.

URUGUAY.

Number of Exhibitors, 35.

SITUATION IN BUILDING.—*North Central Court.*

The Uruguayan exhibition is of a sober description, the only objects with any attempt at luxury being two saddles, and some harness, which are a distinctive feature of this country, the natives going to great expense for them. The ornamentation on the leather, all worked by hand, requires much time and labour. The spurs, with their gigantic steel rowels, would effectually astonish any European horse.

Large quantities of wheat are grown in the country, some of which is of superior quality. Medicinal herbs are important, especially the sarsaparilla, to which some important results are ascribed. It is commonly asserted that, from the great quantities of this plant, many of the rivers are perceptibly tinted with it, and that this produces an excellent effect upon the numerous herds of sheep which graze along their banks, chiefly those of the Rio Negro. Wool is shown in good quality; but sheep breeding on an improved system, and with superior breeds, has only recently been introduced.

The Yerba Maté is used as a substitute for tea. Samples of wood grown on the banks of the Uruguay are noticeable. Tallow is an important article of export, as many as 18,000 to 20,000 pipes being exported to Europe.

The mineral wealth of Uruguay has been but slightly investigated.

VENEZUELA.

This State, the productions of which were till lately so little known, exhibits several objects of great importance. Its coffee, cocoa, and cochineal are of excellent quality.

The cotton is said to equal that of North America in quality, in support of which manufactured samples are shown. A collection of woods, shown, is important for building and manufacturing purposes. Gold, copper, and rock-crystal are found in the provinces of Guayana, Ombrad, and the Teques, and excellent coal in Maracaibo. Some of the copper ores produce as much as 50 per cent. of pure copper, while the gold quartz has been found to produce as much as 100 oz. per cwt.

Among the more attractive objects are the imitations of flowers made by the Indians from feathers.

Ropes made of the cocuiza plant are also noteworthy; this fibre is also used by the Indians in the manufacture of hammocks, which they decorate with coloured stuffs.

An elaborate piece of needlework is exhibited. It is the Declaration of Independence of the seven united provinces of Venezuela.

THE END.

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